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EVOLUTION AND NORMATIVITY

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Dissertation presented in partial
fulfilment of the requirements for
the degree of Doctor in Philosophy

March 2014

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Acknowledgements

There are many people whom I would like to thank for helping me to get where I am today. Firstly, my parents and my brother. Mom and Dad, you have given me so much love, support, and guidance without which I simply would not have had the opportunity to make the decisions that I have made. I love you dearly and thank you from the bottom of my heart. Jeff, you have always been and continue to be an inspiration to me, whether it is with music or with learning. I acquired much of my work ethic, passion, and analytic ways of thinking from you and in this you will always be an inspiration. Secondly, Celia. You have been by my side non-stop for the past 6 years and have helped get me through every up and down of this long and tedious process. You give me the energy and desire to keep going every day and I know that without this I would not have made it. I cannot thank you enough as you are undoubtedly the most important reason for my success. I love you more than words can say. Thirdly, my friends. While many of you are unfortunately far away these days, you have always helped keep me going. To those of you in Nurse: our music and the countless hours spent together are moments that I carry with me to this day. To some new friends, Kris, Allen, Stijn, and James: thank you for all the talks and times spent together. It is amazing what can be accomplished over coffees, teas, burritos, and beers. Finally, my advisors. Prof. Moyaert, you are the reason that I decided to continue my education in Leuven. Your classes were invigorating and our conversations helped to fuel my passion for philosophy. Prof. De Block, you have shown me how enjoyable doing philosophy can be and it is from working with you that I am convinced that this is the career I want to pursue. You have also gone out of your way to help me time and time again, either in terms of funding or reading and re-reading (and re-reading) what I have written. Your comments are always helpful as they curtail my moments of intellectual sloppiness. All of your help is deeply appreciated. Thank you to everyone for everything you have done and continue to do for me.

Introduction

> Those great wars which the body wages with the mind a slave to it, in the solitude of the bedroom against the assault of fever or the oncome of melancholia, are neglected. Nor is the reason far to seek. To look these things squarely in the face would need the courage of a lion tamer; a robust philosophy; a reason rooted in the bowels of the earth.
>
> Virginia Woolf, *On Being Ill*

There are some organisms whose conditions are so rare and so extreme that they seem unnatural and even 'incompatible with life'. Yet, these 'deviant' organisms find a way to survive. One such condition is that of hydrocephalus, or 'water on the brain', a rare condition in which a developing embryo's brain cavities (ventricles) fill with cerebrospinal fluid to such a degree that, despite cranial enlargement, the cerebral cortex is reduced to little more than a thin sheet covering these aqueous orbs. While most instances of this condition result in severe brain damage and require medical intervention, there are many examples of individuals with 'virtually no brain' who have high IQ's, are successful in school, and lead rather normal social lives (Lewin 1980; Amundson 2000). Insofar as such conditions represent significant deviations from not only what is currently considered 'normal' for our species, but also from our biological design that was naturally selected long ago, are we justified in considering all such deviations pathological? If so, how do we explain these transgressions that result in otherwise normal functioning? Such cases force us to reflect on the following questions: Are the concepts of normality, health, and disease simply human constructs, arbitrarily applied to variations of our choosing, or do they have some biological basis? Can these concepts be understood apart from that which makes an individual unique and the environment in which it lives?

One way to approach these questions could be to argue that those variations which result in disease are not unnatural, but are 'the risk of the living as such – risk as much for the animal or the vegetal as it is for the human' (Canguilhem 2012, p. 35). The possibility of disease is a threat to anything that is lucky enough to have made it into existence: from the threat of bacteriophages infecting and devouring the tiniest of bacteria, to the threat of cancerous tumors incapacitating the largest of mammals. If diseases threaten the 'living as such', then it would seem that the concepts of 'health' and 'disease' have rather deep biological roots.

Moreover, while living beings are threatened by disease, they do not remain indifferent to these threats. Bacteria alter their behavior in response to changes in nutrient levels, and, much to the dismay of larger mammals (e.g. humans), they can group together into biofilms so as to survive antibiotic attacks (Poole 2012). A species of wooly bear caterpillars have been shown to significantly increase their consumption of plant toxins to survive parasite infections (Singer et al. 2009). Such behavior aimed at or resulting in self-medication (known as zoopharmacognosy), can also be seen in birds rubbing venomous ants along their feathers to kill lice, in dogs eating grass to induce vomiting and remove intestinal worms, in various mammals eating dirt or clay that flushes out the pathogens in their intestines, and in primates ingesting specific leaves so as to treat infections (Costa-Neto 2012). These behaviors become even more interesting when looking at social animals, e.g. primates, who not only engage in some of these self-medicating behaviors, but who also care for others by licking or cleaning another's wounds, trying to stop bleeding, and even exhibiting some protective behaviors toward handicapped newborns (Fábrega 1997; 2011). While the exact mechanisms for the learning and transmission of such behaviors remain disputed, what all of these actions suggest is that at multiple levels of biological organization, living beings seem to prefer health over disease and this preference often elicits individual or social responses[1].

With humans we see not only more complex responses to this disvalued experience, but also reflections on what this 'deviant' life process is. While setting aside the many different historical theories that have been put forth to explain disease (e.g. humorism, traditional Chinese and Indian medicine, the germ theory etc.) and by fast-forwarding to the mid-20th century, we arrive at another interesting event, i.e. the series of *philosophical* attempts to answer the question: what *is* disease? Of course, reflections on the experience of disease can be traced throughout the history of philosophy, e.g. Lucretius' *On the Nature of Things*, Epictetus' *Discourses*, Plato's *Republic*, Aristotle's *Metaphysics* and *De Anima*, Descartes' *Meditations*, Spinoza's *Ethics*, Diderot's *Letter on the Deaf and Dumb*, Leibniz's *Theodicy*, Kant's *The Conflict of the Faculties*, and Nietzsche's *The Gay Science* and *The Will to Power*, just to mention a few. These philosophers provide many interesting reflections on disease (and health), but none of them really analyzes the concept as such. It seems that it was only when philosophy took a

[1] Of course, such behaviors are the result of natural selection such that it is the differential reproduction resulting from those individuals who successfully distinguished between that which medicated and that which poisoned that allowed the underlying mechanisms associated with these behaviors to be selected. But this does not erase the fact that health and disease appear to be valued differently by living beings.

more focused look at science in the 20th century that disease would become an object of philosophical investigation. Is the particular skin pigmentation found in albinos a disease or just an anomaly? Is having sugar in one's blood on the same level as color-blindness or cancer? While heart attacks and strokes seem to be clearly pathological, how should we conceive of hypercholesterolemia? Are disabilities such as blindness or deafness diseases? What about conditions such as homosexuality or hearing voices? In other words, how should we draw the line between the different and the diseased?

The predominate approach within (analytic) philosophy over roughly the past 50 years has been to employ conceptual analysis, which aims to clarify what it is that is meant by the concepts of disease, health, normality etc. and to establish the necessary and sufficient conditions for the application of these concepts. The general approach is first to see whether a proposed definition is capable of incorporating the stereotypical cases of disease and then to see how the definition deals with some difficult or borderline cases. If it can account for the typical and clarify the difficult, then it is a likely candidate. If, however, a condition that is widely recognized as being pathological is not covered, there is reason to doubt the approach taken. Consequently, the focus has been more on specifying the criteria for inclusion into the class of things we commonly call disease (nosology), rather than on the empirical explanations regarding pathological processes (pathophysiology).

The technique of conceptual analysis has produced several different approaches: naturalism, normativism, and hybrid approaches. According to the traditional depiction of naturalism, disease can be understood in value-free terms, i.e. based on objective and scientific facts, without any initial reference to whether something is desirable (Boorse 1975). Science has produced objective means by which to determine whether a given condition is a disease or not and these should be used so as to avoid the abuses of medical authority. Normativists, on the other hand, recognize that there is some objective difference in nature between what helps or harms an organism, but they argue that the line between this difference and what we call disease is not based on carving nature at its joints, but on what humans consider to be valuable or not (Engelhardt 1976). As such, the question of whether a condition is a disease inescapably reflects human values. While normativists are also concerned with the abuses of medicine, they tend to use these abuses to demonstrate the value-ladenness of these concepts. In response to this dichotomy, some have developed a hybrid approach whereby disease involves both an

objective fact that is determined by scientific judgments and a culturally-relative determination regarding what is socially disvalued (Wakefield 1992).

Criticisms have been leveled at each approach. The naturalist and hybrid approaches have been criticized for not providing a convincing way to objectively determine what is 'normal and natural' (Amundson 2000; Murphy & Woolfolk 2000a,b). The normativist reliance on values seems to require a reference to objective differences at some point (Woolfolk 1999). Consequently, this debate seems to have reached a stalemate: 'Normativism purchases practical applicability at the expense of theoretical incoherence, while naturalism gains theoretical clarity at the cost of defining health and disease in ways unrecognizable by most practitioners or patients' (Hamilton 2010). There have been various responses to this stalemate.

Some argue that there is something wrong with conceptual analysis itself, which is nothing more than a 'misconceived child of a mistaken view of the nature of language and thought' (Millikan 1993). A similar diagnosis has led some to argue that we should simply stop trying to define health and disease (Ereshefsky 2009). In other words, while these concepts will always play a role in popular thought, scientific and philosophical discussions would do better to clearly distinguish the results of scientific measurements (e.g. having X amount of cholesterol) and our normative claims regarding treatment (e.g. whether and how to intervene). This eliminativist approach could be plausible insofar as it reflects what has happened in other debates, e.g. regarding the nature of 'genes' or 'species'. Yet this approach is unhelpful here for a couple of reasons. First, it has been recently argued that the very opposition between naturalism and normativism is a false dichotomy because naturalists readily accept that values will have to be considered so as to understand when and how to treat individuals (Kingma 2013). While we can define disease in value-free terms, naturalists agree that we also need a value-laden concept of disease ('disease-plus') to make sense of treatment and other social concerns. As the two main camps in this debate are much more compatible than usually recognized, it is possible that the suggestions put forth by the eliminativists are already at work in the debate. Be that as it may, there also seems to be some truth to the claim that a 'physician's thought and activity are incomprehensible without the concepts of the normal and the pathological' (Canguilhem 2008, p. 121). If we eliminate these concepts we might help clarify certain arguments, but by doing so we seem unable to make sense of how medical practice is not indiscriminate regarding its objects, as well as the basis for distinguishing two rather different scientific fields which are indispensible for medicine: physiology and pathology.

If, as we saw above, healthy and pathological conditions are distinguished on a *biological* level as organisms react to that which threatens their life, then failing to clarify the distinction between these conditions seems to leave us in the dark regarding some rather fundamental biological processes.

A question that can be raised from the foregoing discussion, then, is whether we are actually in need of a better *biological theory* that provides a causal model to explain what health and disease are, rather than more conceptual analyses of what these concepts mean (Lemoine 2013; forthcoming). Maybe it is the case that conceptual analysis has led to concepts that are 'not cut to the measure of the reality in which we live; they are too wide for reality' (Bergson 2007). In this dissertation I will argue that some aspects of a better biological approach to conceptualizing health and disease could be found in the work of 20th century French philosopher and historian of medicine, Georges Canguilhem (1904-1995). One of the main insights that Canguilhem brings to this debate is that he frames the problem of delineating the different and the diseased within 'the general problem of the variability of organisms and the significance and scope of this variability' (1989, p. 141). If variation and variability are central to biology, then shouldn't our concepts of health and disease reflect these aspects? I submit that this stress on variability could provide us with a different set of biological criteria from which to begin and might help to point out how the current positions in this debate have missed the mark. The aim of this dissertation is to clarify what this 'variability' entails and the implications it has for the typical approaches.

But first: who is Georges Canguilhem? Even up to the present day, he has remained a figure largely in the shadows of 20th century philosophy. He published two books and countless essays on politics, science, and philosophy prior to producing the works for which he would later be known[2]. Much of his influence, however, can be seen indirectly through those of his students and predecessors who would become more well-known, e.g. Michel Foucault, Gilles Deleuze, Louis Althusser, and Alain Badiou, to name a few. Building on degrees in both philosophy and medicine, Canguilhem's main writings range from a (still untranslated) text on the concept of the reflex (1955), to various reflections on medicine and biology, to a text on ideology and rationality in the life sciences (1988a). The texts on which I will largely focus will be his medical thesis, *The Normal and the Pathological* (first published in 1943 and then extended

[2] These two texts and the essays can be found in the recently released first volume of his *Oeuvres Complètes* (Canguilhem 2011).

and republished in 1966), a collection of essays on biological knowledge, *The Knowledge of Life* (first published in 1965), and a posthumous collection of essays on medicine, *Writings on Medicine* (first published in 2002).

While much has been written on Canguilhem's ideas within France, his ideas have only recently been percolating through the wider philosophical and medical communities outside of France (e.g. two volumes of *Economy & Society* were dedicated to his ideas in 1998; Trnka 2003; Nordenfelt 2007; Buchanan 2007; Horton 2009, 2012a, 2012b; Rheinberger 2010; Méthot 2013; Rose & Abi-Rached 2013). With the exception of Nordenfelt, there has been very little engagement with Canguilhem's ideas within those associated with the above debates concerning health and disease. Some of this can likely be explained by the tiresome 'continental' vs. 'analytic' divide in 20th century philosophy, but not entirely. For example, even a very recent anthology of philosophical essays on health and disease in which the contributors often refer to otherwise 'continental' figures offers no dialogue with Canguilhem's ideas (Carel & Cooper 2013). This dissertation will hopefully contribute to showing Canguilhem's relevance to these debates.

As I mentioned above, Canguilhem begins with 'variability'. One basic way of making this vague suggestion more precise is to point out that what is unique about living beings is how their peculiar organization has been undergoing and continues to undergo changes in terms of evolution. This change also occurs during their lifetimes in terms of the physiological and behavioral changes that allow them to meet the demands of their environment, e.g. by avoiding harm and self-medicating. It is the simple idea that 'normality' changes as conditions change, both environmentally and individually, that Canguilhem wishes to capture in his analysis of the concepts of health and disease. If it is biologically normal to change and vary, then could health be better understood as a dynamic process of adapting to changing demands, with disease being some form of reduction in this dynamism? If so, then health and disease are not states, but refer to dynamic interactions between organisms and their environments. Two initial consequences of taking this approach should be mentioned.

First, there is no biological fact that can be called normal or pathological without reference to the conditions in which occurs (Canguilhem 1989, p. 144). As I will explore throughout this dissertation, without reference to the environmental conditions in which a trait, function, or organism operates, there is little meaning to these concepts. If health and disease refer to how organisms relate to their environments, and are not merely statistical

deviations, then a delineation of the different and the diseased will require some reference to this organism-environment relation. Second, biological norms are not only relative to environments, but also to each individual organism, such that what is normal for one could be pathological for another (2008, p. 130). Stressing the variability of living beings leads him to argue that biological norms are not fixed, but temporary and flexible in relation to changing demands.

Some brief examples might clarify what is at stake. If one's theory of disease considers a condition such as myopia to be pathological due to it entailing a deviation from some specified norm (e.g. species norms), then a reference to the environment seems unnecessary. Yet, for Canguilhem, the question that should be asked is whether the given difference helps or hinders an organism's ability to the meet the demands of its environment. Such a difference could therefore take on different qualities in different environments, e.g. myopia posing no problem in a pastoral environment, but becoming problematic when trying to fly (Canguilhem 1989, p. 201). It is thus the fact that the organism cannot meet the demands of a given environment that a difference can become pathological. A clearer example could be that of someone with hypertension who experiences general fatigue, weakness, and possibly chest pains upon moving to a higher altitude. Of course the individual is hypertensive in both environments, but only in the latter does it become pathological. Even in one environment we can see how the same trait (e.g. hydrocephalus) could pose no problem for one individual while in another it could lead to serious physiological damages. These variations are also seen within the same individual organism, e.g. changes in heart rate as a function of changing physical exertion or simply changing capacities as a function of age. Thus normality, for Canguilhem, is a rather supple concept that always brings with it the question: 'under what conditions?' It is by starting from this dynamism and variability that Canguilhem's ideas could be helpful for developing some new biological theories regarding health and disease.

What should be clarified from the start, then, is that when Canguilhem analyzes medical concepts, he does not begin by analyzing what we mean when we say that something is healthy or diseased in the sense of categories, but rather he tries to explain what health and disease are and how these categories tend to arise. Part of this explanation involves showing how organisms value health over disease, as the self-medicating examples suggest, and that this 'valuation' involves different ways of living, i.e. health and disease are distinct biological phenomena regulated by different norms or patterns of behavior. Health is not merely the

absence of disease and disease is not merely a deviation from normality. In what follows, the aim will not be to ask whether Canguilhem is best understood as a naturalist or normativist, as this would be rather uninteresting and would involve taking his ideas out of their historical context and arbitrarily inserting them into another. Rather, the aim is to show that the problems that Canguilhem was interested in, e.g. the variability of living beings, are still with us today and by returning to Canguilhem's ideas we might be able to rethink the terms of the debate and possibly reanimate it.

The first chapter will explore the methodology of conceptual analysis. If Canguilhem is not doing conceptual analysis, then what is he doing and how does it differ from conceptual analysis? Following a discussion of these differences, I will develop a 'biological' genealogy of the two main positions in the debate (naturalism and normativism) based on Canguilhem's ideas. Canguilhem's thought provides an interesting way to trace the roots of these ideas and to show some of their limitations. In the second chapter I will look into Canguilhem's critique of viewing disease as merely a deviation from normality, what I call the 'normalization view', an approach that is common in these debates but which is most evident in the work of Christopher Boorse. I will show that Boorse's understanding of normal functioning actually fails to adequately distinguish normal and pathological variation, i.e. the anomalous and the abnormal, mainly because he fails to account for the environmental relativity of biological norms. This analysis will also involve a discussion of different accounts of function so as to bring out Canguilhem's 'implicit' account of function.

As the second chapter will set out the fact that biological norms cannot be understood apart from the organism-environment relation, the third and fourth chapters will explore the biological bases upon which Canguilhem makes this claim. In the third chapter, I will use a critique of Canguilhem's ideas by Élodie Giroux as a means to explicate what he meant by biological individuality, why health and disease are properties of organisms taken 'as a whole', and whether health and disease can also apply to populations. In chapter four, I will continue discussing Giroux's critique, this time looking at some debates within the philosophy of biology concerning the levels or units of selection and the concept of the organism. This chapter will also allow me to clarify Canguilhem's understanding of biological normativity in terms of the biological properties of plasticity and evolvability. I will suggest that plasticity provides a more concrete way to explain his views on variability and could be one aspect of a better biological

theory for explaining health and disease. Taken together, these two chapters will solidify the contemporary relevance of Canguilhem's ideas.

Since the environmental relativity of health and disease is central to Canguilhem, it seems reasonable to ask whether this relativity is challenged by those who argue that some environments have more relevance than others, e.g. the environment in which the traits which make us humans were selected. In chapter five, I will look at the new field of Darwinian medicine and its claims regarding health and disease. I will discuss three different approaches: a 'Darwinian' one, Jerome Wakefield's hybrid account, and one based on homeostasis. I will point out the limitations to each approach and ultimately show that evolutionary accounts of health and disease remain insufficient to specify what health and disease are. The consequences of these limitations, and the arguments of the preceding chapters, will converge in chapter six, where I provide a more detailed analysis of Canguilhem's organismic and environmental relativity. Not only does Canguilhem aim to contextualize health and disease, but he also refuses to equate health with normality: if being healthy is a matter of changing and adapting, then health is being 'more than normal'. By bringing his ideas together with some concepts from ecological developmental biology and physiology, e.g. phenotypic flexibility and robustness, I will develop a sort of 'updated' version of Canguilhem's definitions of health and disease. I will define health as robust organismic flexibility and disease as an unstable constriction of an organism's capacities in its environment. These definitions will help to capture Canguilhem's insights and suggest a different way to think about health and disease by establishing their biological specificity.

The final chapter explores a potentially problematic result of relativizing health and disease when it comes to human social environments. While it might seem uncontroversial to point out how blood pressure can become harmful in certain environments, it is rather controversial to claim that certain behaviors or lifestyles could become pathological in certain environments, e.g. homosexuality in a homonegative environment. And yet this is what Canguilhem's approach seems to suggest. I will explore whether there is something to the concept of 'social pathologies' and how social norms contribute to the experience of disease. Relativizing the unstable constriction that constitutes disease to a given organism-environment relation might have the interesting therapeutic consequence of focusing more on the environment than the individual organism.

While there are many problems and limitations to Canguilhem's ideas, as well as the more 'updated' versions of them that I develop throughout this dissertation, his ideas should not be overlooked as we explore new ways to think about health and disease. As a whole, these investigations will suggest that while conceptual analysis might not be the most effective way to understand health and disease, we need not take the eliminativist route. Canguilhem's thoughtful engagement with the life sciences might help to guide this investigation by providing us with a set of questions and problems that need to be addressed. By looking deeper into biology, physiology, and pathophysiology, we will not only better understand medical practice and the various ways in which we respond to disease, but, more importantly, we might be able to shed more light on that unsettling process that threatens all living beings.

Chapter One

The Birth of Disease: Conceptual Analysis and Canguilhem's Biological Genealogy

> For there is no health as such, and all attempts to define such a thing have failed miserably. Deciding what is healthy even for your *body* depends on your goal, your horizon, your powers, your impulses, your errors, and above all on the ideals and phantasms of your soul. Thus there are innumerable healths of the body; and the more one allows the unique and incomparable to rear its head again, the more one unlearns the dogma of the 'equality of men', the more the concept of a *normal* health, along with a normal diet and normal course of an illness, must be abandoned by our medical men.
>
> Friedrich Nietzsche, *The Gay Science*

As was pointed out in the introduction, the current debate in the philosophy of medicine regarding the nature of health and disease has led to a stalemate, with serious problems for each of the main positions. Rather than simply abandoning this debate, it seems possible to rethink the method used and to lay out some different claims regarding the role of the life sciences. In this chapter, the central aim is to investigate how Canguilhem's ideas force us to rethink conceptual analysis as a method. One instance of this can be found in Canguilhem's 'genealogical' method and it will have some interesting consequences for the philosophical debate regarding health and disease. What needs to be explained is that if Canguilhem is not doing conceptual analysis, then what is he doing and why is it relevant?

I will first outline a few key characteristics that can be found in those who employ conceptual analysis, e.g. a certain kind of definition, the use of deductive reasoning, and some philosophical implications regarding the focus of analysis and the role of intuition. While these characteristics are not exhaustive and are not found in every approach, they will help to show some potential weaknesses of doing conceptual analysis. I will then show how some aspects of Canguilhem's constructive epistemology diverge from and challenge these characteristics. Finally, I will develop this divergence by sketching what I see as Canguilhem's 'biological' genealogy of medical concepts[3]. Rather than aiming to clarify medical judgment, Canguilhem

[3] There is some precedent and controversy surrounding Canguilhem's 'genealogy of concepts' (Badiou 2009, p. 7). As Méthot points out (2013, p. 115), some commentators have wrongly labeled Canguilhem an 'historian of disembodied genealogies of concepts' who separates concepts from their social and cultural context (e.g. Hodge 2000; Chimisso 2003). In describing Canguilhem's genealogy as 'biological', then, I am situating myself alongside Méthot, and Rheinberger (2010), in the attempt to show how Canguilhem viewed the process of concept formation

can be read as sketching the biological and historical conditions from which the diverging claims concerning the nature of health and disease, e.g. normativism and naturalism, came into being. The point of providing such a genealogy is not to discredit conceptual analysis per se, but to suggest that other biological conditions need to be considered. This chapter, then, will remain a bit superficial regarding the details of Canguilhem's philosophy as these details will be explored in subsequent chapters. Here the intention is to provide a philosophical frame with which to understand his unique approach.

1. Characteristics of Conceptual Analyses of Health and Disease

The method and goal of conceptual analysis, in a broad sense, can be defined as follows:

> The technique involves precisely defining the meaning of a given concept by identifying and specifying the conditions under which any entity or phenomenon is (or could be) classified under the concept in question. The goal … is to improve our understanding of the ways in which particular concepts are (or could be) used for communicating ideas about that field (Furner 2004, pp. 233-234).

The idea for the present debate is that once we clearly state what we mean by 'health' or 'disease', we can then proceed on more solid footing. One of the key roots of conceptual analysis in analytic philosophy of medicine can more or less be traced back to Christopher Boorse's 1975 seminal essay 'On the Distinction between Disease and Illness'. While others such as Thomas Szasz (1960) had already criticized certain medical concepts for being non-scientific 'myths', few critiques sought to employ this analytic method of clarifying exactly what is meant when we use these concepts. Boorse's suggestion for cutting through the conceptual fog was to take a naturalist approach, using objective scientific judgments to define these concepts. By doing so, he set the tone for much of the ensuing debate. This method, be it employed by naturalists or normativists, has some philosophical assumptions tied to it and these require a bit of explication. In this section, I will discuss some of the characteristics that can be found in this debate, focusing particularly on Jerome Wakefield, both because he is rather explicit regarding

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as thoroughly bound up in the experimental and technical practices of living beings. While Méthot outlines the implications this has for philosophy and history of science, I shall concentrate on what it implies for the debates in philosophy of medicine. Though, Méthot mentions the latter debate in another article (2009).

his methodology and because his approach continues to be rather influential within the philosophy of medicine[4].

The first characteristic is that an analysis should arrive at a formalized and universal or a priori definition that stipulates the properties of the class that we call 'disease'. In other words, the claim is that 'X will be considered a disease if and only if certain conditions are met'. As in other areas of conceptual analysis, in any instance where a disease judgment is made what is true for the type must be true for the token (Laurence & Margolis 2003). In Boorse (1977), the conditions for making a disease judgment are formalized into a statistically significant reduction in a given function's causal contribution to the individual's goals of survival and reproduction (relative to age, sex, and race). While Boorse questions that necessary and sufficient conditions will suffice for understanding medical judgments (1977, p. 547), it is clear that his aim was to provide a formalized definition. We can see the stress on necessary and sufficient conditions more explicitly articulated in Wakefield's 'harmful dysfunction' analysis[5]. Wakefield argues that according to his hybrid position something is considered a physical/mental 'disorder' if and only if (a) it is harmful relative to social-cultural standards and (b) it involves an underlying disruption of some mechanism to perform its naturally selected function (1992, p. 382). In both Boorse and Wakefield, then, the conditions for classifying something as a disease are stipulated beforehand and then tested against particular cases.

One consequence of this approach is that it is generally more 'conservative' in that it tends to ignore the empirical details regarding the nature of diseases. As long as a given trait can be said to dysfunction in some vague sense, it is sufficient to classify it as a disease, regardless of the empirical details. Conceptual analysis 'tries to give the meanings of terms without investigating what in the world those terms actually refer to' (Murphy 2006, p. 51). In this approach, empirical findings are, at least in principle, irrelevant since an instance that goes against the definition simply would not make sense (Murphy & Woolfolk 2000b, p. 286). This is probably why most discussions are over counterexamples. This can be shown, albeit somewhat anecdotally, by looking at Boorse's 1997 essay 'A Rebuttal on Health' or Wakefield's countless replies to his critics (e.g. 2011). For example, a suggested counterexample is shown either not to be a counterexample (e.g. because it is not a disease) or that the conditions for inclusion into the class are actually fulfilled, but were misunderstood. The arguments, then, are

[4] At the moment, the point is not to debate the merits of these approaches (this will be done in later chapters), but simply to point out some of their methodological characteristics.
[5] One can find a similar formalization in normativist approaches as well, e.g. Reznek (1987), Cooper (2002).

largely over categorization and rarely delve into asking whether more empirical details are needed (Lemoine forthcoming). In Wakefield, this is tied to the fact that our intuitions or folk concepts are what should guide our definitions. I will return to this shortly.

A second characteristic, which is found in naturalistic conceptual analyses, involves the claim that without knowing what a function is, we cannot determine what constitutes normal (or healthy) functioning and thus what a dysfunction (or disease) is. This relates to the formalized and universal characteristic in that once we establish what 'function' means, we can then stipulate the conditions that specify normal functioning and consequently deduce what is dysfunctional. While the fruitfulness of the final approach will depend on the exact definition of function one provides (Woolfolk 1999), what is assumed here is that 'normality' refers to a given class of traits and is the standard used to determine whether deviations from it are pathological[6]. If, for example, 'function' is defined as the effect that a given mechanism was naturally selected to produce as it tended to aid survival and reproduction, then those mechanisms conforming to this are considered 'normal' and those which deviate from it are 'dysfunctions' (Wakefield 1992). Thus, by starting from the criteria stipulated by 'normal' functioning, we can assume that the judgment that something is pathological is justified without necessarily having to incorporate any empirical considerations about what that dysfunction means for a given individual.

One example of this could be seen in Wakefield's view regarding the role of social values in determining whether dyslexia is a disorder[7]. His basic view is that dyslexia, while involving an underlying brain dysfunction in all cultures[8], could properly be considered a disorder in those societies where literacy is socially valued (since there would be harm *and* dysfunction), but would only be a 'harmless dysfunction' in societies where this skill is unnecessary (1992). More importantly, he specifies that 'in a literate society, a person who does not value reading still has a dyslexic disorder if incapable of learning to read due to a brain dysfunction' (2005, p. 89), as opposed to being incapable because of one's upbringing. Thus, in a literate society the medical judgment that dyslexia is a disorder is justified not because of what

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[6] I will return to this issue in more detail in the next chapter where I look at Boorse's account of normality.

[7] This problem, however, seems to arise in any of Wakefield's typical 'harmless dysfunction' examples. Another interesting example can be found in Boorse's (1975) argument that homosexuality can be considered a disease in a theoretical sense without implying any practical, i.e. medical, consequences. This will also be explored in the next chapter.

[8] I will return to this position in chapters 5 and 7, but will point out for now that it is even problematic to claim that dyslexia involves a dysfunction in Wakefield's evolutionary (etiological) approach (cf. Murphy & Woolfolk 2000a).

the condition means for the individual's way of life, but per definition. After establishing the requirements for what constitutes a dysfunction, all he has to do is see whether the given case fits his stipulated criteria. The contingencies of the individual are irrelevant.

This example nicely leads to a third characteristic of conceptual analysis, which is to start from the conditions of the knowing subject, i.e. the doctor or scientist who makes the medical judgment. By clarifying what is meant by a given concept, the philosopher can provide the medical practitioner with a set of criteria with which to aid the classification of a given instance. In this sense, conceptual analysis is reminiscent of Kant's determinative judgment whereby particulars are subsumed under a universal so as to give them order and intelligibility. While this is clearly an aspect of naturalistic (and hybrid) approaches, it is also at work in normativist positions. Arguing that medical concepts can and should involve value judgments (e.g. Cooper 2002; Fulford et al. 2005) can also imply a 'top-down', doctor-oriented approach. This is largely because conceptual analysis focuses on what health and disease mean for the individual making the medical judgment, rather than for the individual experiencing these conditions or even in terms of the pathophysiology of a given disease. It is in this way that the three main positions in this debate converge on the issue that without being clear about what we mean by the concept of disease, medical judgment seems incapable of preventing its abuse or of saying why a given diagnosis is inappropriate.

As a consequence of this focus on medical judgment, the subjective or 'experiential' aspects of disease, i.e. how it affects the individual's way of life, are not necessarily denied (symptoms are, after all, what tend to bring a condition to medical attention), but are not used to arrive at a given definition. Without denying that objective considerations are crucial for understanding what health and disease are, there are also objective ways to understand these experiential aspects that might challenge medical judgments (some of which will be explored throughout this dissertation). If a given trait is considered to be pathological by meeting the abstract criteria then a reference to what that trait means for an individual in a particular environment can be largely ignored. For example, if a given level of hypotension deviates from species-typical norms such that survival and reproduction are threatened, to use Boorse's criteria, then it does not matter whether the individual is living at high or low altitudes. At any altitude there is a dysfunctional deviation, it just might not be revealed. I will go deeper into this issue in the next chapter, but this is to misunderstand the environmental relativity of biological norms, something that can be revealed by incorporating the experiential aspects of

disease. The point is that it is not so clear that fitting into a category is sufficient to understand what disease is.

A final characteristic to be considered is the claim that one benefit of conceptual analysis is the ability to explain our everyday intuitions. While it is true that our intuitions can lead us astray, e.g. fever seems like a disease but is actually an expected biological response, some philosophers still see them as generally reliable guides to distinguish the normal from the pathological. Boorse maintains, for example, that 'there is a persistent intuition that the average person – or at least the average heart, lung, kidney, thyroid, etc. – must be normal, or we would have no way of telling what the normal person or organ should be like' (1977, p. 546). As with the previous characteristics, this is also rather explicit in Wakefield when he argues that it is our 'intuition' that biological reactions occur on a spectrum, with some being normal or expected reactions and others involving something that has gone wrong, e.g. grief is an expected response to losing a loved one, whereas depressive disorder seems to involve something disproportional that requires more explanation (Wakefield 2000). It seems natural, then, to intuit this difference and it supports the feeling that something is awry when medical judgment differs, e.g. in DSM classifications that seem to pathologize otherwise normal biological processes (Wakefield 2010). This implies that science is more of an extension of intuition than a revision of it. Wakefield is 'searching for necessary and sufficient conditions for the folk concept of mental disorder and assuming that science should search for the psychological processes that fit the concept thus defined' (Murphy & Woolfolk 2000b, p. 289). Establishing necessary and sufficient conditions for what constitutes a disorder, then, serves not only to justify medical judgment, but also to explain how these judgments square with our intuitions.

Interestingly, one could find an analogue to this stress on 'intuition' in a rather different philosopher, Henri Bergson, who sought after a philosophical 'method' for conceptual precision (Deleuze 1988). One of Bergson's claims was that as we experience the unity and flow of being alive, which we are capable of apprehending through introspection, this experience pushes us to see the inadequacy of certain views of life, e.g. mechanistic ones, in that they do not properly capture this experience (Bergson 1971; 1998). It is this intuition which fuels an attempt to develop a concept to better 'fit' this reality (Bergson 2007). Similarly, with Wakefield we could say that as the experience of disease is a human universal, we have the intuitive sense that there is an important difference between normal and pathological processes, e.g. grief and depression

or aggression and psychopathy. The concept of 'disease' just does not seem to 'fit' both conditions and so some conceptual precision is required.

What remains unclear about appeals to 'intuition', be they analytic or 'vitalistic', is that it is not clear why they should be used to help adjudicate scientific judgments. Whose intuitions should we listen to in a given society and why would we expect these to accurately follow nature's articulations? If such intuitions are poor guides for various scientific concepts like 'gene' or 'species', then why would we expect them to help with 'disease' (Ereshefsky 2009)? As Murphy and Woolfolk write: 'Everyday intuitions are not evidence that we understand the role a scientific concept plays in the world' (2000b, p. 286). While an obvious reply could be that 'disease' is different since it involves personal experience, this is unconvincing because we are also alive and this 'intuition' tends to serve as an 'epistemological obstacle' to knowledge about the biological and chemical aspects of life, often leading to animism (Bachelard 2002).

These four characteristics that can be found in conceptual analyses – a stipulative definition, deductive reasoning, a focus on medical judgment, and an aim to explain intuition – are certainly not exhaustive, but they do capture some important assumptions in these debates. While it is a noble aim to provide a clear definition that can serve as a guide to medical practice by justifiably and intuitively determining when the normal becomes pathological, this is not without its limitations.

2. Canguilhem's Constructive Epistemology

By looking at a different set of assumptions found in Canguilhem, we can start to see another way of approaching this debate. First, rather than providing a definition that stipulates the necessary and sufficient conditions for how to apply the concepts of health and disease, Canguilhem describes some basic biological conditions for there to be healthy and diseased norms at all and then constructs his definition from there. Following a general tenet of modern biology, it seems to be a basic property of life that organisms adapt to their environment to survive, either by modifying their behavior or the environment itself. Canguilhem calls this adaptability 'biological normativity' (1989, p. 127), which he defines as the biological capacity to establish a norm in an environment. 'Organisms are normative beings in the sense that, contrary to inorganic matter, they are inevitably affected by their *milieu* and will spontaneously react to external perturbations by making physiological adjustments with more or less success'

(Méthot 2013, p. 118). While Canguilhem's usage of the concept 'norm' can be unclear[9], it generally refers to the behavioral and physiological patterns or regularities that organisms establish and maintain in relation to their environment. As these norms reflect that which helps or hinders an organism's activity they are inherently linked to biological values, e.g. seeking food, survival, avoiding harm, etc. This makes the concept of 'norm' for Canguilhem inherently linked to values and he could be said to provide a naturalized account of valuation. Consequently, health and disease are two 'norms' in that they exhibit distinct physiological/behavioral regularities. This idea will be further clarified throughout this dissertation.

It is from this understanding of life that Canguilhem argues that the concepts used to refer to 'normal', 'healthy' or 'diseased' phenomena are not absolute, but relational concepts (1989, p. 143; 2008, p. 127). It is how a given condition affects the organism's adaptability relative to a given milieu that determines its normality or pathology. In other words, whether or not an individual will thrive or suffer will be a function of the possibilities that the organism's unique physiology provides it when faced with its imposed or selected challenges. What allows for health in one environment, could spell disaster in another. Consequently, rather than stipulating the conditions for knowledge of all possible cases, he begins with an actual property that living beings exhibit.

Second, by beginning from actual conditions, his approach takes on a more inductive or empirical character. While other philosophers in this debate similarly begin with important biological features, e.g. the goals of survival and reproduction, they are employed differently. For those appealing to some form of naturalism, the question is whether or not a given mechanism in an organism deviates from species-typical goals or from its naturally selected function. It is this deviation that then serves to help classify the instance as normal or not. Canguilhem suggests that rather than beginning with the logical relation between normality and ab-normality (the latter being derived from the former), we should start from the specificity of health and disease. 'The content of the pathological state cannot be deduced, save for a difference in format [e.g. the normal becomes *ab*normal], from the content of health' (1989, p. 186). As such, he tries to comprehend health and disease as two separate norms, or, to put it differently, to see disease not as a mere deviation that one derives from normality, but as

[9] Le Blanc (1998) provides a rather lengthy discussion of 'norms' in Canguilhem, but as he never strays very much from Canguilhem's own terminology the concepts remain a bit unclear.

a different 'normal' (Canguilhem 1989, p. 183; 1994, p. 351). By looking at some particular instances of disease, e.g. diabetes, neuroglioma (brain tumor), and cerebral lesions, Canguilhem argues that disease has its own regularities and peculiar causal sequences that one does not find in 'normal' functioning: sugars produce a different set of physiological responses in a diabetic, a brain tumor elicits novel motor excitations or even paralyses, and lesions can force an individual to perform certain actions in ways not found in otherwise normal patients (1989, pp. 80, 184, 193). This aim to think the pathological *qua* pathological[10] can also be found in Italian surgeon-cum-philosopher Mauro Nervi when he writes: 'Instead of considering malfunction as a by-product of identifying physiological mechanisms, one should interpret it as an autonomous pathological mechanism' (2010, p. 227).

Another reason pathology cannot be derived from physiology is that our knowledge of pathologies arises when physiology breaks down and is brought into a clinic, or is broken down in a laboratory: 'Knowledge always has its source in reflection on a setback to life' (Canguilhem 1989, p. 222). In other words, knowledge about what is pathological is not already contained in physiology, as if knowing the latter was sufficient to understand the former. We do not know what the body is capable of until we observe its failures. Pathology, insofar as it is scientific, is not simply a derivation of physiology and thus we should try to comprehend the norms relative to each.

A third aspect of Canguilhem's thought can be described as an attempt to begin from the object to be classified, rather than the individual who does the classifying. This can be understood in epistemological and in medical terms. Epistemologically, Canguilhem's approach embodies a more general shift that scholar Hans-Jörg Rheinberger sees as the 'historicizing' of epistemology in the 20th century: 'A reflection on the relationship between concept and object from the point of view of the knowing subject was gradually replaced by a reflection of the relationship between object and concept that started from the object to be known' (2010, p. 3). For Canguilhem, this means that the relation between 'disease' and the patient must begin from the 'object to be known': the individual organism in its relation to its environment. It is this relation that forms the condition for there to be medical knowledge. In contrast to conceptual analysis's form of determinative judgment, with Canguilhem we could find some affinity with Kant's reflective judgment in that it involves beginning with a novel or singular experience and going in search of a concept to capture it.

[10] The significance of this might still be a bit unclear, but it will be further explained in subsequent chapters.

In medical terms this would entail giving more authority to the patient but without, as he emphatically states, being 'so presumptuous as to pretend to renovate medicine by incorporating a metaphysics into it' (Canguilhem 1989, p. 34). As such, the 'permanent relationship of the sick man and disease' (1989, p. 93), or the 'role and sense of disease in human experience' (2012, p. 40), should not be neglected when conceptualizing disease. By taking this approach, Canguilhem inverts the priority of Boorse's (1975, p. 56) distinction between 'disease' as a scientifically determined category that applies 'indifferently to organisms of all species', and 'illness' as a disease that is deemed undesirable by its all too human bearer. While Boorse sees the former as the proper basis of a scientific judgment, Canguilhem provides the argument that medicine and the judgments it makes are based on the biological implications that these negatively valued experiences have for individual organisms in their milieu. This is not necessarily a matter of *asking* the individual what she things about her condition, but of beginning with the individual's norms[11]. As we will see in the next section, it might behoove philosophers to take this 'experience' more seriously, not by simply arguing that values are important, but by providing a more biologically nuanced or naturalistic account of what this experience entails.

Finally, Canguilhem's empirically oriented constructive approach to health and disease has the further implication that he is not trying to support a folk theory of disease by appealing to some biological aspects of individual experience. In fact, it seems that the contrary is more accurate. It was through his studies of the history of biology and medicine that he was led to reconsider the role of individuality in theories of health and disease[12]. While there are important differences between philosophers who appeal to intuition, e.g. between Bergson and Wakefield, what they seem to share is the tendency to use (philosophical) intuition to criticize the scientific image[13], rather than using science to reformulate philosophical problems (Osborne 2003, pp.8-9; Murphy & Woolfolk 2000b). If Canguilhem criticizes medical concepts, and possibly the judgments based on them, it is not because they differ from our intuitions, but because they do not adequately account for the reality biology describes or the historical

[11] While some other subject- or patient-oriented approaches have been developed (e.g. Sullivan 2003; Carel 2008), there is one interesting problem that they face. By focusing on the patient they struggle to deal with anosognosia, or when someone is unaware that they have undergone some pathological change, e.g. neurological damage. Canguilhem was aware of this problem, especially in the realm of mental diseases (1989, note 37, p. 295), but does not really address it, possibly because his focus was on somatic diseases.

[12] In a somewhat obscure essay Canguilhem argues that 'philosophy must learn from science because only science can tell us what exists' (1967, p. 51). Quoted in Méthot (2013).

[13] 'Wakefield is *criticizing* the scientific, theoretical picture of mental disorder by an appeal to intuition' (Murphy 2006, p. 52).

context that influences how this reality is understood[14]. I will return to these biological and historical conditions in the next section. Furthermore, he argues that intuitions are not free from 'scientific' influence in the sense that scientific ideas can become part of how individuals relate to themselves: 'The body as understood by the people has always been indebted to the body as understood by the faculty of medicine' (Canguilhem 2012, p. 51). For example, it seems 'intuitive' today to say that one's behavior is 'caused' by their genes or can be explained by some quasi-evolutionary story of why some phenomenon was adaptive in the past, but neither claim necessarily reflects an accurate understanding of the theories involved.

What should be clear at this point is that what I have been calling Canguilhem's constructive epistemology can help to point out some of the problems with conceptual analysis while also suggesting some different ways forward. By beginning with a different biological basis, e.g. the adaptability of living beings, he tries to construct a theory of health and disease that is scientifically nuanced without eliding individual experience. To further develop this distinctive approach, I will now discuss what I see as Canguilhem's key insights into how the diverging opinions regarding medical concepts emerged.

3. Canguilhem's Biological Genealogy of Medical Concepts

Insofar as I see Canguilhem as providing a 'genealogy' of medical concepts, I am situating his work in the line of philosophers indebted to Nietzsche or Rousseau, and extending to Foucault and his heirs, whose aim was to uncover the contingencies and historical accidents that allowed for certain ways of thinking or behaving. As Foucault argues in the essay 'Nietzsche, Genealogy, and History' (2003a), with genealogy the goal is not to refer to a definite place and time in history or to seek the origin or essence of a concept. Instead, a genealogy explores a set of contingent conditions, which may or may not still obtain, that shaped the emergence and subsequent understanding and application of a given idea or concept. Canguilhem's biological genealogy, then, could be described as establishing the biological and historical conditions for the fact-value split in the philosophy of medicine. I will show that both naturalism and normativism have their roots in the fact that living beings value health, but draw different conclusions from this by emphasizing different aspects of medical practice and theory. It should

[14] Here Canguilhem comes close to Gaston Bachelard's claim that a properly scientific concept must incorporate that 'concept's conditions of application into the very concept' (2002, p. 69).

be noted that pointing out such roots does not imply that the resulting positions are arbitrary, but is meant to suggest other aspects that need to be incorporated into our analyses of health and disease.

The biological conditions that Canguilhem refers to provide a way to conceptualize the birth of the idea of disease, the birth of medicine, and with them the normativist stress on values. Canguilhem stresses the 'fundamental fact that life is not indifferent to the conditions in which it is possible, that life is polarity and thereby even an unconscious position of value' (1989, p. 126). As living beings are capable of responding to the conditions in which they live, part of what it means to be alive is to establish norms (patterns of behavior), to establish a way of living in a given environment: 'Wherever there is *life* there are norms' (1994, p. 351). This 'biological normativity' can be distinguished along two polarized lines, or 'modes of life': one characterized by propulsive or expressive value and the other by repulsive or conservative value[15] (1989, p. 206). An organism's norms have propulsive value if their stability is only temporary as the organism is capable, given the right conditions, of establishing a new norm. This value entails flexibility or the ability to surpass previous norms. An organism's norms have repulsive value, on the other hand, if they are 'normality-seeking' in that they entail an effort to maintain an achieved stability against any perturbation (Trnka 2003, pp. 431-432). In the former, their flexibility allows adaptation to changing conditions, whereas in the latter their constriction entails a rigid adherence to an established norm.

To make this distinction more concrete, Canguilhem provides the example of immunity versus anaphylaxis[16] (1989, p. 207). An organism whose temporary stability is disrupted by the encounter with a microbe or antigen expresses a propulsive value insofar as it produces the necessary antibodies that immunize it from further disruptions, allowing new norms to be achieved. However, if immunization fails and anaphylaxis occurs (hypersensitivity to new intrusions), then the norm expressed is of repulsive value, i.e., the organism's norm involves an

[15] The roots of this 'dualistic' view can be found in various philosophers, e.g. Bergson's qualitative and quantitative views of life, Nietzsche's active and reactive values, Spinoza's active and passive affects, and even Lucretius (Le Blanc 1998; Daled 2008; Bianco 2013). It seems, moreover, that Canguilhem's point is not to argue for a philosophy of life that characterizes living beings as *essentially* creative, saying that life *is* creativity, but to argue that what characterizes life is its non-indifference 'to the conditions which are made for it' (Canguilhem 1989, p 128). As such, *given the right conditions* living beings *can be* creative and *can* find new ways to adapt, but they can also be rigid or conservative, e.g. when pathological (Canguilhem 1989, p. 199). What life *is*, i.e. whether it is conservative or creative, depends on the conditions in which it occurs. Canguilhem is thus more a philosopher of conditions than a philosopher of creativity.

[16] While this seems like an example that fits all too well, it will actually become more philosophically relevant in chapter 4 when I look into an immunological approach to defining the 'organism'.

overall resistance to change. While it is statistically normal for blood to contain antibodies, there is a qualitative distinction between these two norms for the individual: one allowing for change, the other being catastrophic.

It is this biological distinction that Canguilhem sees as the basis for the phenomena of what we now call 'health' and 'disease': 'It is life itself, through its differentiation between its propulsive and repulsive behavior, which introduces the categories of health and disease into human consciousness' (1989, p. 222). For an organism, these norms have qualitatively different implications and thus express qualitatively different values. The fact that organisms value health can be seen in the many ways in which they try to maintain their behaviors by responding to harm, lesions, infections, etc. It is this same valuation that makes disease a negative value. While this applies to all living beings, it is the human capacity for representation that allows for this difference to be conceptualized. In this way, Canguilhem traces the claim that health and disease are different values back to some fundamental properties of living beings. A similar idea can be found in one of the founders of 'Darwinian Medicine', Randolph Nesse:

> The disease concept must have emerged when people tried to communicate to each other that something was wrong with their bodies, whether from pneumonia, cancer, an infected wound, or kidney stones. People with no idea bout microbes, genes, or even anatomy, must have used the concept of disease to refer quite generally to any undesirable bodily condition, and perhaps to mental conditions as well (2001, p. 37).

Furthermore, this 'birth of disease' factors into the emergence of those responses and techniques aimed at addressing it. Canguilhem argues that the very practice of medicine would not exist if organisms were indifferent to the conditions of their life and to their own suffering: 'no living being would have ever developed medical technique if the life within it – as within every living thing – were indifferent to the conditions it met with' (1989, p. 130). It was this non-indifference that led humans to communicate about their suffering and to seek more effective ways of responding to it. While these responses were initially tied to religious or mystical practices, they were fundamentally in response to vital needs, a response that one sees throughout living beings in their diverse capacities for self-healing, self-repair (1989, p. 127) and even, as was mentioned in the introduction, self-medicating behavior (Fábrega 2011; Costa-Neto 2012). By linking human practices and biological properties, Canguilhem 'naturalizes' or

'biologizes' this axiological aspect of medicine[17]. This provides material support for the claims that organisms 'prefer health to disease' and that in the practice of aiming to restore health the physician 'has sided explicitly with the living being' (1989, p. 222). Claiming that human medical technique is an extension of 'vital impulses' (1989, p. 130) simply means that medicine has its roots in biological responses to the problems that pain, suffering, and disease, i.e. norms with repulsive or negative value, pose to living beings.

One important aspect of normativism, that health and disease reflect *human* values, is thus easily traced back to medical practice as a response to negatively valued experiences. The medical categories of health and disease arose out of biological techniques and subjective experiences of them (Canguilhem 1989, p. 222) and by taking this perspective he is capable of accounting for why 'the very origins of the disease concept involve a value judgment' (Nesse 2001, p. 37). However, with Canguilhem we can go further and trace this valuation back to the non-indifference of living beings that allowed for medicine and the health-disease distinction to emerge. Values thus seem unavoidable not only because medicine (as a whole) aims to treat what individuals consider 'undesirable', but because the practice of medicine is an extension of biological capacities, e.g. self-repair, and techniques, e.g. self-medication. In this debate, 'desirability' could act as a sort of epistemological obstacle to understanding values from a biological perspective. Canguilhem's approach provides a naturalistic account of how valuation is a biological technique before being expressed in medicine: 'It is life itself and not medical judgment which makes the biological normal a concept of value and not a concept of statistical reality' (1989, p. 131). Thus, the normativist position is not only about human values, but also involves the claim that 'all living beings *value* health'. By stressing valuation on a biological level, the human subjective valuation of health and disease is explained.

Interestingly, this biological aspect also allows us to uncover the roots of the naturalist aim to define disease objectively. In other words, this biological non-indifference is interpreted by naturalists as the claim that '*all* living beings value health'. This slight difference in

[17] Thomas Osborne claims that Canguilhem's project is a sort of naturalized epistemology 'if we take the problematizations of the sciences as in some sense the raw material of problems of life themselves.' (2003, p. 9). This stress on naturalization can also be found in Malcolm Nicolson's reading of Canguilhem as a realist and materialist in the sense that knowledge and techniques are based on the 'biological mechanisms for processing information and discriminating one thing from another' (1991, p. 356). Interestingly, Nicolson adds that this aspect of Canguilhem, grounding human practices in biological mechanisms, 'might also serve as a useful antidote to irrealist and idealist tendencies within the sociology of scientific knowledge itself' (1991, p. 348). Finally, Élodie Giroux (2010, p. 20) describes Canguilhem's stress on the fact of biological value, or of describing normativity in terms of biological capacities, as 'anti-reductionist naturalism', a phrase borrowed from Céline Lefève.

emphasis entails a shift from focusing on subjective values to focusing on how health and disease are objective facts and therefore demand objective definitions. This leads us to another implication of Canguilhem's genealogy. While these biological conditions were used by normativists to explain medical practice, naturalists used them to explain medical theories. The need for an 'objective' and naturalistic explanation for pathology can already be found in Greek humorism, but it was following some developments in the 19th century that naturalistic explanations stood on slightly more solid ground.

The primary scientific roots for naturalism can be found in the introduction of statistics into the life sciences in the 19th century, as seen in Belgium with Quetelet, in France with Bernard and Comte, in Germany with Fechner and Rautmann, and in England with Galton and Pearson (Vácha 1985). This gave rise to a more abstract quantitative view of disease that would potentially elevate medicine to the status of the 'hard' sciences (Hacking 1990). Canguilhem argues that it was in the attempt to provide a statistical explanation for what was studied experimentally in the clinic (pathology) that physiology would take on epistemological priority: hence the attempts to deduce the pathological from the 'normal'. In their drive for objectivity, this could explain why naturalist theories tend to ontologize disease, seeing it as essentially the breakdown of a localized part or mechanism, even if the breakdown is explained in terms of causal contributions to an organic system (Boorse) or in terms of naturally selected functions (Wakefield).

To develop this genealogy of naturalism further, we could add that the 19th century idea that disease is essentially a 'deviation from a norm' (Hacking 1990), i.e. a 'purely' statistical deviation, is also rooted in how medical practice is led to conflate the anomalous and the abnormal. The following lengthy quote captures this dynamic:

> Because there are anomalies which are experienced or revealed as an organic disease, there exists first an affective and then a theoretical interest in them. It is because the anomaly has become pathological that it stimulates scientific study. The scientist, from his objective point of view, wants to see the anomaly as a mere statistical divergence, ignoring the fact that the biologist's scientific interest was stimulated by the normative divergence. In short, not all anomalies are pathological but only the existence of pathological anomalies has given rise to a special science of anomalies which, because it is science, normally tends to rid the definition of anomaly of every implication of a normative idea' (Canguilhem 1989, p. 136).

In other words, as the only anomalies that elicited medical attention were *harmful* anomalies (i.e. abnormalities), all anomalies were thought to be abnormalities. By equating a descriptive term with a normative term, the abnormal could be confusedly conceived as a purely statistical deviation: to be diseased was to be different. Naturalism takes up this problem in the attempt to establish a value-free concept by siphoning off these initial normative aspects. As we will see in the next chapter, Boorse's biostatistical account is heavily indebted to these statistical views of disease. While Wakefield's hybrid account in some ways revives a more 'holistic' view[18] by trying to incorporate facts and values, its appeal to evolution is not without its problems (see chapters 5 and 7).

As a result of this genealogical picture we can see some of the roots to the two main approaches in the philosophy of medicine. Normativism finds its explanation in how it links the biological non-indifference of living beings to the medical practice of treating the undesirable. This stress on subjective human values rests on how all living beings *value* health. Naturalism finds its explanation in how it links this same non-indifference to the attempt to base the irregularities found in pathology on solid physiological (statistical) laws. This stress on objective facts rests on how *all* living beings value health. This helps to account for the fact that in these debates both sides generally accept that health and disease are objectively different, though the question is whether this difference can be determined on purely objective grounds[19]. Through this biological genealogy Canguilhem presents us with a naturalized account of values or even a naturalized normativism. Rather than stressing one side or another, his account implies a 'universal subjectivity' (2008, p. 132). As I will show in subsequent chapters, this is not merely a matter of methodology, but involves a reconfiguration of the terms of the debate.

4. Consequences and Conclusions

[18] See Nordenfelt (2007) for another attempt (inspired by Canguilhem) at providing a more holistic view of health and disease.

[19] Sedgwick, however, diverges when he writes that there are 'no illnesses or disease in nature. … The fracture of a septuagenarian's femur has, within the world of nature, no more significance than the snapping of an autumn leave from its twig … Out of his anthropocentric self-interest, man has chosen to consider as "illnesses" or "diseases" those natural circumstances which precipitate … death (or the failure to function according to certain values)' (1982, p. 30; quoted in Wakefield 1992). In my opinion, such claims are based less on political concerns than on an ignorance of biological processes and actually contribute to a rather reductionist understanding of biology. If there is no difference 'in nature' between leaves falling and legs breaking, then biological explanations provide no further information than physical laws.

As conceptual analyses aim to stipulate universal properties of a class, they tend to miss some crucial insights which might help to provide a more philosophically and biologically nuanced concept of disease. By looking into the constructive or empirical aspects of Canguilhem's epistemology and by examining what I have called his biological genealogy of medical concepts, we can see how he puts forth a unique perspective in this debate and might provide an answer to the methodological stalemate. Insights from Canguilhem's genealogy would provide a rather different starting point than the typical normativist-naturalist divide and, as we have seen, could help to explain this very divide. By tracing these biological and historical conditions, we see not only what made these two positions possible but also their limitations. In this sense, Canguilhem's thought could serve as a 'critique' of them[20]. The aim of this critique, however, would not be to point out the limits of all possible knowledge of disease, but to show how the individual experience of disease is a recalcitrant philosophical problem for conceptualizing disease. A proper account of health and disease, then, would incorporate these conditions and their implications into it.

We can take from Canguilhem the suggestion that rather than starting from a fixed definition or set of diagnostic criteria that one then tries to impose onto the murky border between the normal and pathological, we can start from a more biologically informed account that helps to explain what health and disease are and construct a definition from there. Instead of starting from the concept of disease as it is used by doctors, we can start from what the disease means for living beings dynamically interacting with their environments. In other words, by appealing to the biological conditions of health and disease, these concepts are understood relative to a given organism in its environment. Abstracting from these conditions would be to miss what a given 'deviation' means for an organism's way of life, e.g. whether it is abnormal or just an anomaly. For Canguilhem, the question of what a given deviation means for an organism's flexible capacity to meet environmental demands does not involve an a priori determination, but can only be determined by the individual organism in its particular environment. 'Health [for Canguilhem] is not defined by the doctor but by the person, according to his or her functional needs. The role of the doctor is to help the individual adapt to their unique prevailing conditions. This should be the meaning of "personalized medicine"' (Horton 2009, p. 781). As such, Canguilhem's approach may even help combat the

[20] In one of his last works, *Writings on Medicine*, Canguilhem called for a '*Critique of Practical Medical Reason*' (2012).

decontextualization of a patient's symptoms that is often lamented in contemporary debates (e.g. Wakefield & First 2012). What remains to be seen, however, is whether Canguilhem's peculiar biological approach can be used to improve the philosophy of medicine debate along the lines suggested by Lemoine (2013), i.e. trying to 'naturalize' the concept of disease by starting from a better biological (i.e. explanatory) theory. The next chapter will start to answer this question by confronting Canguilhem with a prototypical naturalist: Christopher Boorse.

Chapter Two

Towards a Critique of Normalization: Canguilhem, Boorse, and Functions[21]

> [He] thought he was normal, like everyone else, when he imagined the crowd in abstract, a great, positive army united by the same feelings, the same ideas, the same aims; and it was comforting to be part of this. But as soon as individuals emerged out of that crowd, his illusion of normality shattered against the fact of diversity.
>
> Alberto Moravia, *The Conformist*

In biomedical discussions, it is often the case that arguably the most crucial concept is taken for granted as being self-evident: normality. Yet the various meanings of the concept of normality undermine its self-evident application: e.g. the most frequent, the average, that which conforms to a type, that which occurs in healthy individuals, or an ideal to be attained (Vácha 1978). As we saw in the previous chapter, these various definitions have their roots in 19th century attempts to bring statistics into the biological and medical realms. While the statistical view of normality has been critiqued since its inception, a more recent formulation of it can be found in the biostatistical account of normality and disease defended by Christopher Boorse (1975, 1977). What Boorse and these 19th century positions have in common is that they all assume an epistemological priority to normality such that it is in relation to what is deemed normal that we can determine the abnormal or the pathological: the normal is the standard by which divergences are measured. I shall label this view, also encountered in discussions on bioethics, disability and health care ethics, the normalization view[22] (cf. Whitehouse et al. 2004; Daniels 1987; Amundson 2000).

In this chapter, I will attempt to flesh out some recurring forms of the normalization view, ultimately claiming that those theories that aim to provide a statistical account of biomedical concepts, such as normality or abnormality, harbor problematic assumptions concerning the very concepts they seek to clarify. I will do so by first discussing some important aspects of Canguilhem's philosophy. His analyses of the epistemological and

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[21] A modified version of this chapter is to appear with the title 'Towards a Critique of Normalization: Canguilhem and Boorse', co-authored with Dr. Andreas De Block, in D. Meacham (Ed.), *Medicine and Society: New Continental Perspectives* (Dordrecht: Springer).

[22] In an essay on Canguilhem, François Dagognet (1985, p. 30) describes Canguilhem's critique of prioritizing normality as an attack on the 'edifice of normalization' that was largely established by positivism.

existential relations between normality and disease will help to point out some of the common ways of thinking that this normalization view employs and some of the problems surrounding its formulation. Second, this will help to question the very meanings of normality and abnormality that are commonly found in naturalistic approaches, such as Christopher Boorse's. I will show how despite Boorse's appeals to biology to clarify biomedical concepts, normality is still viewed as both an average and an ideal, which ultimately undermines a coherent philosophical account of these concepts. Rather than concluding that such a problem renders the health/disease distinction illusory (Amundson 2000), I will argue that without a proper philosophical account of normality the ability to provide a more biologically accurate definition of health/disease will be hindered. In the third section, I will explore how Canguilhem delineates normal and abnormal variation. To do so, I will consider the insight from Canguilhem, corroborated by various findings in biology and medicine, that no organism or environment is normal in itself, but it is the historically changing relations between organisms and environments that make them normal or not. I will then have to show how Canguilhem's 'ecological' understanding of biological function can be situated within philosophical debates regarding functions and whether his approach can escape some of the problems commonly encountered. Canguilhem's account suggests an interesting challenge: any naturalistic account of normality and abnormality has to acknowledge that 'normality' implies variability, the ability to transgress previous norms. If there is no 'normal' organism (Nesse 2001), no trait which is normal or pathological *in itself*, we seem led to define normality relative to the individual organism and its environment. Finally, I will conclude by posing some problems that arise with this 'relativistic' account of normality and disease.

1. Three Problems of Normalization

In order to elaborate a critique of the normalization view, I will first focus on what I see as three interrelated problems inherent to it: quantification, abstraction, and exclusion. The next section will discuss these problems in relation to Christopher Boorse's theory of disease, as he allows us to test Canguilhem's insights against one of the most influential naturalist views.

In his central text, *The Normal and the Pathological* (1989), Canguilhem provides both a critique of certain concepts within the history of the life sciences as well as a novel way to rethink these concepts. By tracing the historical alterations that these scientific concepts have

undergone and by acknowledging the variability of biological norms he is able to uncover some problems inherent to what I am calling the normalization view. For example, the normalization view understands the abnormal in relation to an abstract statistical norm from which it deviates. However, this means that the normalization view runs into a problem precisely because it overlooks how the meaning of normality and pathology could be constructed from the organism's[23] non-indifferent relation to its environment. It also overlooks the historical conditions that allowed for abnormality to be considered as a mere deviation from a statistical species norm. Thus, the relation of normality and pathology to individuality and the environment has to be reconsidered. This admittedly abstract sketch of the normalization view and its problems could be made more concrete by considering the following questions: How did the statistical or quantitative view come about, what exactly does it amount to, and what are some examples of the recurring problems for such theories?

As was mentioned in the previous chapter regarding the genealogy of naturalism, the quantitative approach to disease was developed by various philosophers and scientists throughout the 19th Century who attempted to rethink the relation between physiology and pathology, e.g. Quetelet, Bernard, Fechner, Rautmann, Galton, and Pearson. I will further explore the implications of that genealogy here by discussing two historical factors that were important for the development and scientific popularity of the normalization view[24]. First, there was a general aim to make physiology a more rigorous (nomological) experimental science that would approach the achievements of the physical sciences. Posed in this way, individual variations and pathologies became regrettable irregularities or 'errors of measurement' whose underlying cause had to be explained so as to arrive at the supposed laws or regularities of physiology (Vácha 1985). Concomitantly, this understanding of 'normality' became possible through the rise of statistics in the 19th century (particularly Gauss' normal distribution curve) and its importation into the life sciences by biologists and physiologists who sought to speak more objectively about human beings (Canguilhem 1989; Hacking 1990). It has been argued that from their inception these understandings of normality have been plagued by a possible conflation of facts with values: normality as not only the average, but also what is right or what

[23] In this chapter, I will be using 'individual' and 'organism' interchangeably. In the next chapter, I will distinguish between these concepts so as to clarify that health and disease apply to individual organisms but not all biological individuals, e.g. populations.

[24] To clarify, what I call the 'quantitative' view is a statistical view of disease. This view was modified in the 20th century to produce different naturalist views of disease, one of them being Boorse's biostatistical account. It is my contention here that the 'normalization' view is at work in both: Boorse inherited it from the 19th century quantitative view. I partly established this genealogy in the previous chapter, and flesh it out further here.

ought to exist. Ian Hacking summarizes this view as follows: 'The normal stands indifferently for what is typical, the unenthusiastic objective average, but it also stands for what has been, good health, and for what shall be, our chosen destiny' (Hacking 1990, p. 169).

The basic idea behind the quantitative aspect of the normalization view, then, is that the statistical norm, as studied in physiology, takes precedence over the abnormalities and variations studied in pathology, entailing that the abnormal is merely a quantitatively determined lack or excess in relation to this norm. As mere quantitative deviations, or differences in degree, abnormalities can be derived or deduced from normality: they still refer to an underlying normal functioning, but with something added or lacking: 'diseases are merely the effects of simple changes in intensity in the action of the stimulants which are indispensible for maintaining health' (Canguilhem 1989, p. 48). Canguilhem challenges this by arguing that if there is no quality to quantitative variation[25], then first, physiology has nothing new to learn from pathology, and second, biology and the life sciences more generally have nothing more to say concerning the nature of anomalies, sickness or death than physics or chemistry (1988a). If the difference between the normal and the pathological is merely quantitative, it becomes redundant and scientifically useless to distinguish between physiology and pathophysiology. By using the pathological to clarify the normal, the normalization view prevents the study of the pathological *qua* pathological.

This quantitative theory of disease also rests on the problem of abstraction whereby individuals are detached from their concrete circumstances by means of statistical analysis (Canguilhem 1989, p. 88). In order to determine pathological deviations, normality must first be established by abstracting from within individual (e.g. physiological fluctuations) and between individual (e.g. gender, geography, job differences, etc.) variations. The normalization view often assumes that there is an underlying type or essence to which all organisms can be identified, with such variations being only accidental quantitative deviations. However, Canguilhem points out that from the very conception of this view in the 19th century, Claude Bernard already had his reservations since 'the use of averages erases the essentially oscillatory and rhythmic character of the functional biological phenomenon' (1989, p. 151).

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[25] A certain reading of Canguilhem's focus on the quality of disease should be avoided. Canguilhem does not simply *prefer* quality over quantity, as if appealing to something intractable for scientific investigation, as is often implied (e.g. Chimisso 2003; Roudinesco 2008). Instead, he argues that when dealing with living beings, quantitative changes always have a qualitative significance: quantification cannot erase quality, but neither does quality erase quantity: 'The substitution of quantitative progression for qualitative contrast in no way annuls this opposition' (Canguilhem 1989, p. 111; 1988a, p. 141).

Furthermore, this abstraction grounds the supposed epistemological and therapeutic priority given to normality, with normality either serving as the goal of knowledge or the goal of medical intervention in its attempt to restore nature's order[26]. In an essay on Canguilhem, Paul Rabinow describes this view as follows:

> Previously, medical training in France had privileged the normal; disease or malfunction was understood as the deviation from a fixed norm, which was taken to be a constant. Medical practice was directed toward establishing scientifically these norms and, practice following theory, toward returning the patient to health, reestablishing the norm from which the patient had strayed' (1994, p. 15f).

This reasoning is confronted with several problems. First, how do some variations result in disease in some individuals, whereas in others they pose no problem, as seen in the example of hydrocephalus or in multifactorially inherited diseases like cancer, hypertension or schizophrenia where environmental factors play a large role in how and whether the variation is expressed? Second, it seems obvious that there are variations that are not pathological even though they are deviations from this natural norm. Why is having green eyes not pathological if only 2% of humans have green eyes? Thirdly, even if variations and 'oscillatory and rhythmic' properties are acknowledged, any judgment that a trait or individual organism is 'normal' remains insufficient apart from the conditions in which it appears: behaviors, duration, previous state of the individual, environment, etc. As I will discuss below, it seems more accurate to argue that the normality of a trait, e.g. being able to read, digest lactose or even to run quickly, depends on the environment in which the organism develops and on its chosen or imposed demands. Statistical abstractions would thus seem to offer no means *in themselves* for distinguishing between normal and abnormal variation (Canguilhem 1989, p. 155).

Finally, the problem of abstraction as the basis of knowledge of normality leads to the problem of the exclusion of differences. If diseases are explained by their relation to what is statistically normal then insofar as they are different, they involve a contaminated or distorted normality: disease becomes an aberration which threatens our understanding of nature's regularity. 'From this perspective, the singular – that is, the divergence, the variation – appears to be a failure, a defect, an impurity' (Canguilhem 2008, p. 123). In the aim to establish how

[26] For Comte, 'The identity of the normal and the pathological is asserted as a gain in *knowledge* of the normal' and for Bernard 'The identity of the normal and the pathological is asserted as a gain in *remedying* the pathological' (Canguilhem 1989, pp. 43, 44; emphasis added). Canguilhem (1989, p. 45) points out that Nietzsche was also influenced by Bernard's view that pathology illuminates normality.

nature's lawful regularity creates ideal or normal organisms, variations are turned into unnatural, deficient or excessive deviations: as the normal is the index for what *ought* to exist, the abnormal becomes unnatural, what *ought not* to exist.

In all three instances, pathology is subordinated to physiology since disease is incapable of being a norm in itself apart from its relation to normality. Succinctly, it is because the abnormal is a quantitative deviation from a norm understood as an underlying essence that it can be considered unnatural. For the normalization view, then, the anomalous and the pathological are reduced to epistemological obstacles impeding the knowledge of normality, on the one hand, and to therapeutic obstacles to medicine's supposed goal of re-establishing or maintaining physiological constants, on the other. Specifying these aspects can help to flesh out the genealogy of naturalism developed in the previous chapter.

2. Boorse's Naturalism as an Example of Normalization

A more recent attempt to uphold a similar line of argumentation can be seen in the work of Christopher Boorse (1975; 1977; 1997) who has argued for biostatistical, and value-free, concepts of normality and disease. I will outline the main arguments presented by Boorse and show how he exhibits the three problems pertaining to normalization as discussed above.

Boorse develops his naturalistic theory in contrast to the normative view that health and disease imply value judgments, such as being desirable. Boorse (1975) claims that the 'normativist' position is problematic when it comes to accounting for undesirable conditions that are not diseases. For example, infertility might be undesirable, but abstracted from the actual organism it is unclear, for normativism, whether it should be considered a disease. Moreover, many conditions that predispose people to immoral or even criminal behavior are undesirable, but there seems to be a strong argument in favor of the claim that dispositions to immoral or criminal behavior are not – or at least not necessarily – diseases. To better clarify disease, then, he aims to abstract from questions of desirability and to develop his own naturalistic account of disease. Boorse calls this account the biostatistical theory of disease as it combines elements from (evolutionary) biology with statistical elements. In his view, the evolutionary elements neutralize the philosophically untenable implications of a purely statistical account, and the statistical elements neutralize the philosophically untenable or

implausible implications of a purely evolutionary account[27]. For example, unlike a purely statistical account of disease, Boorse does not have to argue that being statistically rare for a population is sufficient to understand disease. Having green eyes or red hair (or both) might entail a significant deviation from the norm, without entailing a disease. However, Boorse does run into a problem on the other end of this spectrum, e.g. so-called 'universal diseases'. Does bird flu, for example, stop being a disease as soon as everybody has bird flu (because having bird flu is statistically normal)? Boorse could argue that the bird flu would still be a disease because it hampers the functioning of species-typical processes that contribute to the survival and reproduction of organisms of that species. He could also see this as a non-starter since it is unlikely that everyone in every relevant reference class will have bird flu simultaneously. In this sense, he would agree with Canguilhem (1989, pp. 183, 269) that, statistically speaking, there are instances in which it can be normal to be pathological. Regardless of these possible replies, the issue of universal diseases remains a problem for Boorse (Kingma 2010).

In Boorse's biostatistical theory, 'the normal is the natural', in the sense that normality, which is the state of being free of disease and is equated to health, entails a 'mode of functioning [which] conforms to the natural design of that kind of organism' (1975, p. 57). As organisms are composed of a hierarchy of goal-directed functions, he posits the existence of a reference class of uniform functional design, such that 'normal function' implies a statistically typical contribution to the goals of survival and reproduction (1976, p. 79). One can describe three aspects of this species-typical view of normality: quantitative, qualitative, and dispositional normal function. Qualitative normal function refers to the causal contribution that a function gives to survival and reproduction, whereas quantitative normal function refers to the efficiency of that function (Kingma 2010). This can be seen in the distinction between whether an organ, such as the liver, performs its species-typical function of filtering toxins (qualitative), and whether it does so within the statistically typical level of efficiency (quantitative). Dispositional function (Kingma 2010) refers to the 'readiness' that a given part has to perform 'all its normal functions on typical occasions with at least typical efficiency' (Boorse 1977, p. 562). As such, a function can be considered normal, and thus healthy, even if it is not currently being used. Just because we are sitting does not mean we are paralyzed. This appeal to species-typical functions suggests a description of health and disease that makes no reference to whether physiological

[27] I will take up the issue of an evolutionary, or etiological, account in later chapters when discussing Darwinian medicine and Wakefield's harmful dysfunction account.

functions are valued, or to an individual's desired goals – which would smell too much of 'normativity' – but entails the objective empirical determinations of whether and to what degree a function contributes to physiological goals.

As I have already mentioned, statistics are not sufficient to determine health or disease, since unusual conditions can be healthy and unhealthy conditions can be common (Boorse 1977, p. 546). Nevertheless, Boorse maintains that 'there is a persistent intuition that the average person -- or at least the average heart, lung, kidney, thyroid, etc. -- must be normal, or we would have no way of telling what the normal person or organ should be like' (1977, p. 546). Moreover, our 'species and others are in fact highly uniform in structure and function; otherwise there would be no point to the extreme detail in textbooks of human physiology' (1977, p. 557). Thus, the *intuition* that the normal is average is retained because of the need for a standard, in the sense of the highly uniform species norms that have arisen and are maintained by natural selection (and expertly described in textbooks!). Since some of these norms that natural selection has established are not only relative to species, but also to sex and age, the reference class – the class that sets the standard or the norm – is not limited to the species but also includes age groups and sex groups (1977, p. 558). For instance, a condition that is species typical (e.g. the ability to control one's emotions), but not typical for pre-adolescent males of that species, would count as statistically abnormal for that reference class and could thus be a diseased process if it occurs in pre-adolescent males of that species. This latter relativity shows Boorse attempting to account for some individual differences, but, as we will see below, he does not go far enough.

While claiming to be value-free, the language used to describe health and disease should not be overlooked as it contains interesting metaphysical presuppositions. Boorse begins from the view that the 'perfect working order' of biological function implies the 'conformity of the process to *a fixed design*', or '*the* human design'[28] (1975, pp. 59, 60; emphasis added). It is this that allows him to equate health and 'functional normality' (1975, p. 60) and to see disease as a statistical deviation from the 'natural functional organization of the species' (1975, p. 59). Boorse admits that such a view of natural functions is indebted to Greek philosophy (he mentions both Plato and Aristotle) insofar as it presupposes ideal physiological types which allow for comparisons, even if no actual organism exhibits this ideal (1977, p. 557). This

[28] For another defence of 'normal function' as that which is fixed by nature and thus allows for the objective determination of health care goals see Normal Daniels (1987).

standard of normality that allows for health judgments is assumed to be inherent to the structure of the organism (1977, p. 554). One can see here an echo of the 19th century physician Claude Bernard who assumed a similar Platonic lawfulness of biological phenomena, with individuals diverging from types: 'truth is in the type, reality is always outside this type and constantly differs from it' (Bernard, quoted in Canguilhem 2008, p. 123). As reality is in the type, the individual becomes an obstacle to establishing lawful guidelines for medical practice. While for both Bernard and Boorse it is the type and not the individual that matters for medical judgments, for Boorse this type is statistically determined, whereas Bernard saw it as arising from natural regularities akin to those in physics and chemistry.

It is also interesting to note that Boorse sees his theory as following in the medical tradition of Galen, whereby disease is 'unnatural' in the sense that it is 'contrary to Nature' or 'foreign to the nature of the species' (1977, p. 554), either by being atypical or, if considered statistically normal, such as human tooth decay, as a result of interactions with a hostile environment (1975, pp. 59, 65). In fact, Boorse's view combines the ontological and statistical theories of disease. In other words, the 19th century view discussed above that disease is a quantitative deviation (an excess or deficiency) from the norm is combined with the ontological theory, solidified in the 18th century by the Italian anatomist Morgagni, which claims that disease is a localized occurrence *happening to* the organism, rather than being a disruption of the whole organism (Porter 2002, p. 73). This ultimately allows him to define health and disease theoretically, without recourse to the practical and normative concerns of the clinic. As we will see, these metaphysical presuppositions continue to haunt Boorse's theory.

At first sight, there is much to praise in Boorse's view. His naturalistic view of disease has the advantages (1) of appealing to physiology and evolutionary biology so as to avoid the perils of pure normativism, (2) of being applicable across biological taxa (Nordenfelt 2007), and (3) of acknowledging that statistical deviations alone cannot account for how some deviations are abnormal and others are not (Boorse 1977). However, this view still falls prey to the three problems mentioned above. (1) While the quantitative view is meant to set aside practical, clinical issues, can the difference between normal variation and abnormal variation be properly understood without appealing to its clinical significance[29], i.e. to the practical concerns of what a given variation means for an individual and its way of life? (2) Second, the issue of abstraction

[29] Méthot (2009, p. 45) also shows that Canguilhem and Boorse diverge when it comes to the role of the clinic in conceptualizing disease.

emerges in the claim that underlying the irregularities of biological phenomena is the objective fixed design of the ideal organism that is established when the naturalist abstracts from 'individual differences and from disease by averaging over a sufficiently large sample of the population' (1977, p. 557). As such, Boorse's Platonism (and thus typological and anti-darwinian thinking) forces him to abstract from the actual individual for whom health is much more than merely the absence of disease or conforming to species-typical norms. While he might agree and simply point to his account of 'positive health', the problem is much deeper. (3) Finally, while he does acknowledge that variation is part of normality (1977, p. 563), the issue of exclusion remains when disease is seen as a failure or regression that is 'unnatural' and 'foreign' to the species: 'Diseases are, so to speak, failures to get as far as the rest of the species has been for millennia' (1977, p. 563). Despite his naturalistic approach, disease falls outside of nature, a mere derivation from naturally selected normality, and thus teaches us nothing about nature itself, except that it can, sometimes, go wrong.

We can see these three problems converging when Boorse discusses the controversial claim that homosexuality could be considered a disease since it is a deviation from one of the species-typical goals of sexuality, i.e. reproduction (1975, p. 63). Heterosexuality, by implication, is the normal, natural (and thus healthy) function of human sexuality since it conforms to this goal. David Hull (critically) summarizes such a view as follows:

> Heterosexuality is the normal state programmed into our genes. It needs no special explanation. Normal genes in a wide variety of normal environments lead most children quite naturally to prefer members of the opposite sex for sexual and emotional partners. Homosexuality, to the contrary, is an abnormal deviation which needs to be explained in terms of some combination of defective genes and/or undesirable environments (1998, p. 390).

This captures what is at stake in the naturalistic view by explaining disease as either atypical or resulting from an environment gone wrong. Boorse adds that such an example shows how our desires or behaviors might not conform to the species design and that in the case of homosexuality we would be better off asking what difference such a diagnosis would make. As biological normality is not a good in itself, but only instrumentally good in terms of contributions to the biological goals of survival and reproduction, then if one is happy with what he calls 'a psyche full of deviant desires and unnatural acts' (1975, p. 63), maybe it makes no difference on a practical level whether homosexuality would be a disease on the theoretical

level. Homosexuality, in other words, might be a disease, without it being an illness in need of treatment. Is this not a prime example of normalization, whereby sexual variations are quantified (homosexuality as a deviation from sex norms)[30], viewed abstractly (as theoretically diseased), and excluded (as unnatural and deviant acts)? While it remains open for Boorse as to the value of sexual deviations and whether they should be medicalized, it is problematic at best to assume that such judgments about the variety of human sexuality in relation to ideal references classes, not to mention other forms of behavioral diversity, are free from being evaluative (Brown 1985; Kingma 2007).

I will now look at what might be the biggest problem for Boorse's account, which is the problem of distinguishing normal from abnormal variation. Boorse tries to solve this problem by invoking evolutionary elements. According to his view, deviations from statistical norms are not pathological as long as they do not undermine the trait's species-typical contribution to survival and reproduction. Furthermore, Boorse thinks that evolutionary theory supports his reliance on statistics. After all, natural selection tends to increase the frequency of adaptive and heritable traits in a population until these traits become the statistical norm (or 'fixed'). Having opposable thumbs is the statistical norm in our species because natural selection has resulted in the spread of that trait in our species. The ideals of biological design are then maintained in nature by 'normalizing selection' (1977, p. 557).

There are, however, several problems with this reliance on evolutionary theory. First, it can be instructive to mention that some evolutionary theorists (and philosophers of biology) seem to call into question this stress on statistically determined norms by pointing out that variation is inherent to human populations. This seems to imply that

> […] there is no one normal genome for the body. Likewise, there is no one perfect phenotype. There are just phenotypes that emerge from the products of genes interacting with environments. Thus, there is no ideal type to use as a benchmark for comparison to determine what is normal and what is not (Nesse 2001, p. 44).

Yet, even Nesse seems to agree with Boorse that any deviation that negatively influences the ability of a bodily mechanism to perform its 'normal function' in a given environment should be considered a disease: 'Disease is a disadvantageous difference from normal'[31] (Nesse 2001, p. 41). While Nesse claims to challenge the view that normality is an ideal that can be determined

[30] In fact, sexual desires for males are species typical: more than half of the population consists of individuals that have sexual desires for males. However, such desires are not typical for males.
[31] I will discuss Nesse's view in more detail in chapter 5.

apart from the organism's, or the gene's, relation to a given environment, his account of normality still refers to a supposedly 'objective' standard in the form of what is 'usual' for a given species (2001, p. 44).

This is where a second problem arises: why would such evolutionary concerns be decisive for our judgment about health and disease? This problem can be formulated as follows: (a) trait T is not typical for an age group of a sex of our species whereas T' is typical, (b) individuals with T have on average lower reproductive success than individuals with T', and yet (c) it would be wrong to call T a disease (or it is at least uncommon to think of T as a disease). Since there are plenty of examples of such traits, Boorse's account fails. For example, there seems to be a curvilinear effect of height on reproductive success in human males: average height men, compared to shorter and taller men, attain the highest reproductive success (Stulp et al. 2012). If one would apply Boorse's account to this example, one could conclude that only men of average height are normal and that all significant deviations from this norm imply some form of pathology. Yet, this conclusion is highly problematic. First, men of above average height are usually not seen as suffering from a disease. Secondly, the average that seems to matter here is not an average height of men in our species, but rather the average in a particular human population. In the US, males of average height have higher reproductive success than taller or shorter males, e.g. males of 178.2 cm have higher reproductive success than males of 184.8 cm. But in the Netherlands, males of 184.8 cm are of average height and they have more reproductive success than Dutch males of 178.2 cm. Would Boorse conclude that 184.2 cm is normal in the Netherlands but not in the US because Dutch men of that height have a higher than average reproductive success, whereas American men of that height have a lower than average reproductive success? In my view, this conclusion is absurd. The absurdity points out that adding another reference class (e.g. nationality) to the already existing reference classes in Boorse's account (age, sex, and species) will not do[32]. As such, the problematic nature of the concept of normality remains, as do the limitations of a biostatistical approach, with disease still being conceived as a deviation from supposedly objective biological norms.

While Boorse and other naturalists are right to critique normative theories for viewing biological norms solely in terms of social ideals or subjective evaluations, the claim that these

[32] Canguilhem captures a similar problem with references classes when he writes: 'The fact that an old man exhibits functions included in the 68% corresponding to his age is not sufficient to qualify him as normal to the extent that the physiological normal is defined in terms of a margin of security in the exercise of functions. Aging is expressed, in effect, by the reduction of this margin' (1989, p. 267).

norms are better understood in relation to an objective species-typical design is to overlook an important problem with species-typicality or types more generally. By claiming to simply describe nature's norms, Boorse makes the unfounded assumption that his reference class is sufficiently uniform (Hull 1998). Moreover, he ignores the fact that biological organisms tend to adapt to changes in their environments. As long as these adaptive changes result (on average) in more reproductive success, Boorse would not call them diseases. Yet, he would have to conclude that individuals that are unable to adapt to new environmental circumstances, but that do conform to a species-typical (and age- and sex-typical) average, are not suffering from a disease, even though this 'common' phenotype would turn out to be fatal for that organism. It seems that one should take the evolutionary challenge more seriously than Boorse does[33]: there are no ideal genotypes or phenotypes, 'no norms in evolutionary biology' (Ereshefsky 2009, p. 225), but simply gene-environment interactions that produce a variety of functions and behaviors (Pigliucci 2001). To better conceptualize health and disease, this variability has to be accounted for.

3. The Abnormal and the Anomalous: Shapes and Forms against the Norm

The 'challenge' of evolutionary biology is two-fold: taking variation seriously and properly accounting for the role of the environment in determining 'normal' or abnormal functioning. In this section, I will explore how Canguilhem's account responds to both aspects of this challenge and in the next section I will bring out some of the implicit assumptions regarding functions that his 'ecological' approach seems to harbor.

This challenge was explicitly discussed by evolutionary biologist Stephen Jay Gould when he argued, following Ernst Mayr, that one of the recurring philosophical obstacles to understanding evolution is the tendency to abstract from variation and accidents so as to arrive at the Platonic 'essence' of a given thing. This view, epitomized by Boorse's theory, regards 'variation as a pool of inconsequential happenstances, valuable largely because we can use the spread to calculate an average, which we may then regard as a best approach to an essence'

[33] See also van der Steen and Thung (1988, p. 90) for a similar critique that Boorse's view does not adequately account for how environmental changes produce physiological changes. The reference values used to establish 'normal' function cannot be separated from the environment in which they occur, thereby undermining Boorse's idealized account of normality. Van der Steen and Thung accuse Boorse of appealing to hypothetical 'non-biological' environments and thus of doing 'bad biology'. More recently, Ananth (2008, pp. 159-161) argues that, despite his attempts, Boorse has not provided a convincing reply to these critiques.

(Gould 1996, p. 41). Conversely, a crucial insight of Darwin's theory is that variation is irreducible in nature: 'in Plato's world, variation is accidental, while essences record a higher reality; in Darwin's reversal, we value variation as a defining (and concrete earthly) reality, while averages (our closest operational approach to "essences") become mental abstractions' (1996, p. 41). But if philosophers of medicine appeal to evolutionary biology to support their theory, then why does such Platonism continue to be an epistemological obstacle to understanding health and disease[34]?

As was discussed in the previous section, Boorse himself acknowledges that statistical deviations are not sufficient conditions to determine whether a given phenomenon is a disease. I believe that one of the main problems with Boorse's account is that statistical abnormality is not a necessary condition either. Rather than just accepting this as a difficulty inherent to statistics, however, my intent is to show why this difficulty arises. If we begin with the view that normal and abnormal variation are two kinds of natural variability, rather than with the view that abnormality is 'foreign' to an underlying species design, then we can address this recalcitrant Platonism. In other words, if we embrace variability and individuality in biomedical discussions, we will be better equipped to avoid the problem of placing undue emphasis on the 'mental abstractions' of species-ideals.

One way to address these limitations can be found in Canguilhem's claim that if variation is a natural part of nature, not only between species and populations within species, but also between individual organisms, then 'normality' should reflect these individual conditions. Instead of approaching physiological and biological issues from the perspective that life is essentially lawful and orderly, Canguilhem explores the implications of considering life in terms of 'an order of properties', by which he means that living beings are hierarchically organized entities whose functional stability is 'necessarily precarious' as they are constituted by a sort of compromise between conflicting forces (2008, p. 125). While this talk of forces has a Bergsonian or Nietzschean ring to it, his aim is to comprehend life as that which is 'not indifferent to the conditions in which it is possible', but is instead a matter of polarity (1989, p. 126). As such, organisms are entities whose precarious organization reflects a temporary and flexible solution to particular ecological conditions which are themselves shaped by the

[34] While my critique largely focuses on essentialist assumptions, a different argument for retaining universals in a nomological sense could also be made (cf. Machery 2008).

organism's responsiveness to these conditions[35]. Within such a view, 'irregularity and anomaly are conceived not as accidents affecting an individual but as its very existence' (2008, p. 125). By 'anomaly', Canguilhem is simply referring to individual variations or differences. By explaining how no two individual organisms are alike, evolutionary biology provides some support for Leibniz's identity of indiscernibles: every organism is, in some sense, an anomaly[36]. With this idea Canguilhem critiques the view that a divergence from life's supposed essence should be considered an error or failure. Under the guise of a judgment that hypostatizes normality and views the laws of nature as Platonic essences, individuality can be nothing more than 'a provisional and regrettable irrationality' (2008, p. 125). Instead, for Canguilhem, 'a living species is viable only to the extent that it shows itself to be fecund, that is, productive of novelties, however imperceptible these may be at first sight' (2008, p. 125). Such a view fully embraces Gould's (and Mayr's) 'Darwinian reversal' whereby variation is that which defines biological reality.

With Canguilhem's approach we can better understand the distinction between 'anomaly' and 'abnormality', as well as the tendency to conflate mutations, monstrosities[37], and diseases (Blumberg 2009). For example, if deviation from the species design is retained as the central reason for qualifying something as a disease, some problems emerge. On the one hand, a genetic mutation expressed in the phenotype which deviates from the typical species design could entail the possibility of a new variety. On the other hand, an organism whose physiological mutation prevents adaptation in one environment could force it into a new environment where it would flourish as a function of the changed conditions. The problem for Boorse is that with such mutations the typical reference classes are insufficient to decide between anomaly and abnormality. As such, on both accounts the normalization view seems to be led into the paradox of calling these mutations both normal, insofar as their form is maintained via reproduction, *and* pathological, insofar as they are significant deviations from species design (Canguilhem 1989, p. 144). While it could be objected that such mutations do not result in sub-normality, but super-normality, the insufficiency of statistical measures remains.

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[35] 'A living being is normal in any given environment insofar as it is the morphological and functional solution found by life as a response to the demands of the environment' (Canguilhem 1989, p. 144).

[36] 'An anomaly is a fact of individual variation which prevents two beings from being able to take the place of each other completely' (1989, p. 137).

[37] While fascinating, I will set aside the discussion of anomalies and monstrosities. Suffice it to say that, for Canguilhem, monsters are negatively valued in that they are 'nonviable' forms (2008, pp. 135-136).

For Canguilhem, such anomalies would only be pathological due to their inability to establish a new norm, not in terms of their deviation from some species ideal. Conversely, the 'normality' of such anomalies would be based on their ability to survive in the new environment: 'biological normality is determined by the interaction between structures and behaviors, on the one hand, and environmental conditions, on the other' (1994, p. 352). Some recent findings in the field of developmental plasticity suggest that a 'non-typical but viable phenotype is not *broken* by its failure to comply with some imagined blueprint for its species. It will function anyhow, in spite of its atypicality' (Amundson 2000, p. 39). One interesting example is that of the goat born without forelegs but which, through various morphological and physiological alterations, was able to adapt to living as a biped (West-Eberhard 2005a). Irregularities force us to rethink the role of order in nature: when faced with this goat without forelegs, should we focus on the fact that it has two legs too few, that it *fails to conform* to the species-design, or on the fact that this anomaly was *only* that extreme, that it did not deviate further from the norm[38]? Such examples suggest that while biological processes do contribute to the goals of survival and reproduction, these processes often have no inherent aim at reproducing identical functioning, but are plastic or flexible so as to produce a variety of functional adaptations depending on the environmental demands (Amundson 2000, p. 43). While some aspects of this anomalous goat will still be similar to others of its species, comparisons to other goats will be a bit handicapped when it comes to determining what is normal or pathological for this goat's unique morphology and physiology.

It thus seems possible to argue that it is not relative to a species ideal, but to how the individual organism or function finds its way to live and operate in relation to various environmental demands that the distinction between anomaly and disease should be determined. In this view, mutations are not pathological simply because they are anomalous or atypical; they are neither normal nor pathological in themselves, but only in relation to the organism and its environment. 'These two [anomaly and mutation] express other possible norms of life. If these norms are inferior to specific earlier norms in terms of stability, fecundity, variability of life, they will be called pathological' (Canguilhem 1989, p. 144). Insofar as an anomaly allows for a new norm to be established, in that it is stable, fecund, and variable, it need not be considered pathological, no matter how rare it is. Conversely, if the anomaly

[38] This is a play on Canguilhem's own question regarding the epistemological lessons to be drawn from monsters: 'When faced with a bird with three legs, should we be more sensitive to the fact that it has one leg too many or to the fact that it has *only* one more?' (2008, p. 136).

hinders this stability, fecundity, and variability, thereby preventing the organism's adaptation, it will cease to become a mere structural or functional deviation. Instead, as it entails a disruption of the organism's course of life it will constitute a pathological anomaly[39]. Of course, one can object that this distinction is rarely contested, but the point is that within the normalization view, this distinction can become obscured, and possibly conflated, if it does not fully account for the organism-environment relation.

To address such an objection, Boorse does say (1977, p. 566) that structural deformities are only diseases when they disrupt species-typical normal functioning. However, the point that I wish to make is that it is not merely by a divergence from species-typical functioning that the anomalous becomes abnormal, but *relative to the individual organism for whom the deformity may or may not inhibit some function or behavior in a given environment.* The example of the anomaly thus seems to be the exception that proves the rule regarding the relativity of health judgments (Canguilhem 2008, p. 129). Boorse is correct to argue that statistical divergence is insufficient, but he does not follow through with the implication that what is needed is an extension and limitation of naturalism: extended so as to include the particular environment in which a function operates (the inner milieu) or in which an organism lives[40], and limited by making the individual organism the crucial reference class. This would not imply a denial of physiological regularities, but rather would acknowledge that biological norms result from historically and environmentally contingent behaviors whose variability goes beyond sex and age to include the specific demands of everyday life:

> Instead of considering a specific type as being really stable because it presents characteristics devoid of any incompatibility, it could be considered as being apparently stable because it has temporarily succeeded in reconciling opposing demands by means of a set of compensations. A normal specific form would be the product of a

[39] '…diversity is not a disease; the *anomalous* is not the pathological. Pathological implies *pathos*, the direct and concrete feeling of suffering and impotence, the feeling of life gone wrong' (Canguilhem 1989, p. 137). This could be one way of addressing a problem that Canguilhem's account faces by comparing the individual to itself. How are we to determine health or disease if an individual is born with a congenital abnormality? One response could be that only those congenital anomalies that prevent the organism from establishing a norm that can meet environmental demands (i.e. is stable and flexible), would be diseases or congenital *ab*normalities. This issue, however, remains unclear in Canguilhem's account.

[40] In fact, Kingma (2010, p. 247) claims that the 'situation-specificity' of functions seems to be implicit in Boorse. However, she admits that by making such an element explicit, she could be modifying the theory. Moreover, by including it, it leads his theory into a fatal paradox: if he rejects it, his theory is biologically inaccurate, but if he accepts it, he cannot adequately conceptualize situation-specific diseases, e.g. liver failure as a result of being poisoned. It is my contention that even if such an element is implicit in his theory, the implications of making it explicit require some changes that Boorse would likely object to, such as the individual relativity of health judgments. This will be taken up in the next section.

> normalization between functions and organs whose synthetic harmony is obtained in defined conditions and is not given (Canguilhem 1989, p. 162).

Normality is thus the contingent and precarious *effect* of the competing demands of the organism and its environment. Rather than abstracting from such specific conditions, a theory of health and disease would do better to embrace them.

A few examples regarding the environmental and organismic relativity of disease can help to illustrate this point and show the limitations of the naturalistic approach. First, it has been argued that dyslexia need only be considered a dysfunction within an environment where the behavior of reading is widespread and socially valued (Wakefield 1992). It seems, at the least, very awkward to say that people in illiterate societies can have dyslexia. A similar argument could be made for being short-sighted: 'With a disability like astigmatism or myopia, one would be normal in an agricultural or a pastoral society but abnormal for sailing or flying' (Canguilhem 1989, p. 201). To take another example, whether seasonal affective disorder (SAD) is considered a dysfunction can change depending on an individual's country of origin and their current environment. Someone from Africa diagnosed with SAD can be said to have a dysfunction while in Africa, but upon moving to a northern climate the changed environment can render the condition livable, thus negating the diagnosis of having a dysfunction *in that environment* (De Block 2008). These examples can help to account for the role that social norms and cultural practices play in shaping diagnoses, and they exemplify Canguilhem's claim that there is no normal or pathological phenomenon in itself but only through its relation to a particular (bio-social) environment.

The example of international differences regarding the ability to digest the lactose found in cows' milk (Canguilhem 1989, p. 168) and how this ability is based on differing social norms further illustrates this relativity. More recently, this example of relative differences in the presence of genes for lactose absorption has been described from the perspectives of niche construction and gene-culture co-evolution (Laland, Odling-Smee & Myles 2010). These theories argue that it was not because there were such genes, maintained because conforming to some underlying species ideal, that the practice of dairy farming emerged, but rather that the activity of dairy farming itself created a niche with the selection pressures for such genes to become normal (Laland, Kendal & Brown 2007, p. 55). Here what becomes normal is based on different ways of life, not vice versa, thus showing how physiology can be shaped by historically changing practices of niche construction (or more simply 'culture'). Furthermore, whether or

not a given trait or mutation, such as the inability to digest lactose, needs to be diagnosed as a disease depends on whether a given individual is in an environment where dairy is consumed. In other words, it does not depend on the average impact of dairy consumption on the reproductive success and longevity of the average human, but on the individual in its environment. Gluckman, Beedle and Hanson point out the difficulty in defining disease in such an example:

> Can we really say that the majority of humans have a disease because they do not carry a single nucleotide polymorphism that causes lactase to persist into adulthood, a deficiency that is of no consequence for their health or fitness in the context of an environment free from cows' milk? Rather, should we label the species-atypical state of lactase persistence in people of northern European origin as the *abnormal* condition and then reflect on the context-sensitive dichotomy between abnormality and ill-health? (2009, p. 5)

What these examples suggest is that as physiological changes occur within and because of human norms, it is not the average that determines norms of life, but norms of life that determine what will be considered average (Canguilhem 1989, p. 178). The point is not to deny that some conditions such as lactose persistence can become statistically average in a given population, but to stress the fact that such averages are the result of historically changing human activities and environments and thus medical judgments concerning the nature of such conditions would be more accurate if determined relative to such norms. While Boorse might be right in arguing that all abnormalities are anomalies, i.e. all abnormalities are deviations from some norm, what he does not adequately show is why some anomalies are not abnormalities. It seems that he would be content with labeling dyslexia, myopia, or SAD as diseases regardless of the environment in which they occur and regardless of what they mean for any particular individual (e.g. Boorse 1977). As I hope to have shown, this is a problematic position. Rather than shying away from the context-sensitivity of medical judgments, the organismic and environmental relativity of health and disease might help to clarify that obscure line between normal and abnormal variation.

4. Canguilhem's Implicit Account of Function

After exploring the implications of the 'evolutionary challenge' to take variation and environmental relativity seriously, I will now discuss one way to interpret Canguilhem's implicit account of biological functions as an 'ecological' or relational account and how this shapes his view of disease. Before arriving at Canguilhem, I will first briefly describe the main positions within the philosophical debate regarding the nature of biological functions. My intention is not to present an exhaustive account of this debate, but merely to lay out the main positions so that we can see whether Canguilhem's approach opens itself to similar problems[41].

One prominent view of functions is the backwards-looking or etiological account of function, typically attributed to Wright (1976), and later to Millikan (1989) and Neander (1991). Wakefield's 'harmful dysfunction analysis' (1992) and much of the recent work within the field of 'Darwinian Medicine' (e.g. Nesse & Williams 1994) are also based on this account. According to this view, a function is conceived as the effect that certain traits had on survival and reproduction in a past environment which thereby allowed them to be favored by natural selection. Thus, the selected effect oddly explains the cause of a trait's current existence analogously to how the intended effect of producing a tool explains the cause of its being created (Wakefield 2011). Conversely, insofar as a trait fails to perform its naturally selected function, it can be called a dysfunction.

Various limitations to this approach have been pointed out, e.g. some explanations for traits need not rest on natural selection, some traits have no etiological function but are by-products of other selected traits (e.g. so-called 'spandrels'[42] like the chin or the ability to read), and some naturally selected functions can still be disorders, e.g. phobias, where an excessive response is naturally selected, even though it can be harmful, because the cost of not responding is too big (e.g. Boorse 1976; Woolfolk 1999; Murphy & Woolfolk 2000a,b; Murphy 2006). What should be clear is that this is not the account of function at work in Canguilhem, since his environmental and organismic relativity says nothing about past selection pressures, but instead refers to what variations mean in given environments.

A second view, which is possibly the most prominent functional account within biomedicine, is what could be called the present-looking or ahistorical account, which was first put forth by Cummins (1975) and later modified and defended by Boorse (1976). According to

[41] Much of this section is indebted to Woolfolk's essay 'Malfunction and Mental Illness' (1999). For more on this debate see Sterelny & Griffiths (1999) and Wouters (2005).
[42] This term comes from the now infamous 1979 essay by Gould and Lewontin on 'The Spandrels of San Marco and the Panglossian Paradigm'.

this account, a function is that which causally contributes to the overall performance of a specified system, e.g. what Cummins describes as the 'genetic plan' of an organism (1975, p. 750). As such, a function can be ascribed without referring to the history of the trait or the environment in which it occurs. Conversely, a dysfunction would occur when the trait fails to perform its causal contributions to the present system or organismic 'plan'. Boorse, as we have seen above, updates this account by linking the causal contributions to goal-directed organic systems, on the one hand, to the physiologically relevant goals of survival and reproduction, on the other (1976, p. 84).

While the ahistorical account is still largely what guides medical science in that it determines *how* a trait functions regardless of *why* it exists (Schaffner 1993; Murphy 2006), it has its limitations. For example, it has been argued that as functions are artifacts of how a system is described, this could make nearly any effect of a trait a function and nearly any negatively valued causal outcome a dysfunction (Wakefield 2001). Moreover, it is not always clear that when a given trait fails to perform a species-typical function, e.g. when in a different environment, that the trait is dysfunctional (Millikan 1993). As we will see below, while Canguilhem's account is similar to this in that he sees the organism as an organized system of interrelated part, he continually stresses how this system cannot be understood without reference to the environment the organism partakes in constructing.

A third view is the forward-looking propensity or dispositional account, which finds its roots in Bigelow and Pargetter (1987). This view is, in some ways, meant to contextualize the ahistorical account. According to this view, a function is to be understood based on its capacity to enhance fitness across possible environments[43]. As a function is what a given trait will contribute to fitness, this allows for the claim that traits can change functions depending on their environment or even lose functionality if they no longer enhance fitness. A dysfunction, then, occurs not when a trait fails to perform its naturally selected function, but when it fails to enhance the individual's capacity to survive and reproduce in its present and possible environments.

This account nicely approaches the environmental relativity that I have been examining in this chapter, but it also has its weaknesses, e.g. it still relies too heavily on reproductive fitness even though this need not play a role in health judgments (Woolfolk 1999) and it is too

[43] As was mentioned in a previous footnote, Kingma (2010) tries to see how this aspect is also at work in Boorse's ahistorical account of function. In doing so, he is open to the problems of both accounts.

flexible in that it seems to allow for any capacity of a trait to be considered a function (Godfrey-Smith 1994). Moreover, it fails as a description of Canguilhem's account in that by indexing functional ascriptions to possible or even 'appropriate' environments it struggles to account for the potentially beneficial effects of novel traits (Walsh 1996) and effectively blurs the line between anomalies and abnormalities. For example, there is no 'appropriate' environment for a novel trait and so even if it enhances survival in a given environment, the dispositional account cannot say it is a function, whereas Canguilhem would likely claim that it is functional precisely because of these effects.

The final view to be considered is a modified version of the propensity account that was developed by Walsh (1996) with an aim to more adequately account for novel traits and the environmental relativity of functions[44]. I will deal with this one in a little more detail since it seems closest to Canguilhem's ideas. According to this relational account, a function is not an intrinsic property of some trait, but should be determined in relation to a given set of selection pressures. As such, a function is 'the contribution that a trait makes to *average individual fitness* with respect to a regime' (1996, p. 565; emphasis in original), with 'regime' being the relevant environment in which the given trait is being positively selected[45]. A dysfunction occurs when the trait fails to contribute to the average individual fitness in that environment or 'regime'.

The benefit of this relational account is its ability to combine the insights of etiological and ahistorical explanations, without falling into their problems. The ahistorical insight, one that is commonly found in biology, is that if a given trait enhances fitness in a current environment then this should be sufficient to consider it a function. Walsh claims to account for this by arguing that a trait can enhance fitness in one environment by performing one function and could enhance fitness in another environment by performing a different function, regardless of its past history (1996, p. 565). Insofar as it contributes to the average individual fitness relative to the current environment, it has a function *in that environment*. The etiological insight is that by referring only to current conditions and neglecting past history nearly anything could be considered a function/dysfunction, thus undermining this very distinction

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[44] Another account of function that could have been discussed is Mossio, Saborido & Moreno's (2009) organizational account, which is meant to address the shortcomings of many of these approaches by focusing more on self-organizational properties. I was unable to address every account, but this organizational account would likely have provided more support for Canguilhem's view.

[45] Walsh adds (1996, p. 565) that describing function as 'average individual fitness' is not to be confused with trait fitness since, with the latter, a trait may have high fitness, i.e. be highly prevalent, without enhancing a given individual's fitness. This is meant to incorporate Sober's (1984) claim that the selection *of* some traits can be seen as a by-product of others that were selected *for*.

(e.g. Millikan 1993). Walsh's response is that only those traits which on average contribute to individual fitness are selected for in a given environment and are thus functions. Just because something enhances fitness and is selected does not mean it has a function, e.g. accidents or effects of other selected functions (1996, p. 567). Possibly the most interesting aspect of this account is that it is capable of explaining these two divergent approaches in the following way: 'When we specify that the relevant selective regime is to be a *past* environment, we get historical [etiological] function. When we specify the current regime for a character, we get ahistorical function' (1996, p. 570). Both accounts can be accommodated by (a) indexing etiological claims to past environments while incorporating their explanation regarding a trait's current prevalence, and (b) allowing for current contributions to fitness to determine a traits current function (or propensity). Consequently, the relational account commits itself to neither of these approaches, but sees them as instances in which it is applied. As this account is not restricted to past selection environments, nor does it struggle to deal with changing environments, it can accommodate these divergent yet useful biological explanations.

Despite its benefits, the relational account encounters two interesting problems when it comes to dealing with human (social) environments. First, like the propensity account mentioned above, it is unclear why fitness is a necessary requirement, since otherwise healthy individuals could choose not to reproduce (e.g. homosexuals or Catholic priests) or fitness could be a function of height, as mentioned above, and yet we would not attribute these to dysfunctions. Second, there is the more interesting issue that arises when we consider that conforming to social norms is clearly fitness enhancing. As such, this view seems led to label those traits that do not allow an individual to conform, and thus partake in fitness enhancing behavior in a given environment, as dysfunctional. Consequently, it seems unable to prevent diagnostic misuses such as drapetomania (Woolfolk 1999, p. 665). Boorse provides a similar critique of viewing health as adaptation to a given environment by arguing that while one's functional abilities might aid survival and adaptation in that environment, the lack of these abilities need not be pathological (1977, p. 549). He agrees that a given trait could be bad for an individual in some environment, but he finds it problematic to claim that that same trait should be considered pathological.

Could this relational account be modified and improved by incorporating Canguilhem's insights? Before proceeding, it should be noted that bringing this debate to bear on Canguilhem is problematic for two reasons. First, there is no general 'theory' of functions

elaborated in his work, even though he frequently uses the concept. Finding such a theory will thus be somewhat arbitrary. Second, as I discussed in the previous chapter, Canguilhem does not approach normality, health, and disease in a deductive manner (i.e. function → normal function → dysfunction), but instead aims to think the pathological *qua* pathological. These problems being stated, I feel that a dialogue is helpful here, not only as a way to clarify some aspects of Canguilhem's work, but also to bring a new voice to the debate.

With this in mind, I will now try to bring out what I see as Canguilhem's implicit account of function and then show how it is at work in his account of disease. On the one hand, his account shares with Boorse the idea that biological functions are hierarchically organized and contribute to the behavior of the organism as a whole: 'in the living organism all functions are interdependent and their rhythms coordinated' (1989, p. 84). Both would agree that to understand what a function is and the significance of a dysfunction, one must place the given function within the 'whole of functional totality' (1989, p. 87), a view both received from Cannon's work on homeostasis and the (then) newly emerging field of cybernetics[46] (Sherrington in the case of Canguilhem (2008, p. 72) and Sommeroff for Boorse (1976, pp. 78-79)). Moreover, Canguilhem would seem to share Schaffner's claim that etiological accounts of function are 'parasitic' on a 'secondary sense' of function, i.e. 'some organ, mechanism, or process is "useful" to the organism in the sense that it keeps it alive and/or allows it to thrive' (1993, p. 389). As such, he takes up a similar stance as the ahistorical account in seeing organisms as goal-directed systems.

On the other hand, Canguilhem's claim that organismic normality can only be determined in relation to the environment would distance him from the tendency of ahistorical accounts to bracket the environment in favor of species ideals or plans. For Canguilhem, as we have seen, the living being and its milieu cannot be considered normal in themselves since 'it is

[46] This similarity breaks down, however, when Boorse compares organisms to a car's design that can be described in purely functional terms without reference to a designer's intentions, e.g. 'perfect working order' as conforming to a 'fixed design' (1975, p. 59). He adds that this mechanistic analogy seems 'exact' when health ideals are determined empirically with reference to a species design. This supposed exactness seems to claim either that there is no fundamental difference between mechanistic and organic functioning or that there is something 'fixed' about species design. This can also be seen when he describes disease as a breakdown of the typical, naturally selected 'physiological machinery' (1977, p. 550). Canguilhem, on the other hand, was very critical of importing mechanistic metaphors into biology. While he provides rather strong philosophical and historical arguments for why this is problematic (2008, ch. 4), he also provides biological ones. For example, he mentions the 'vicariousness of functions' and the 'polyvalence of organs', i.e. functions can be taken over by other organs in the vicinity of one which fails and organs can take on multiple functions (2008, pp. 89-90). While this variability is not infinite, it is sufficient to undermine these machine metaphors. For some recent critiques of mechanistic language in biology see Dupré (2012) and Nicholson (2012).

their relationship that makes them such' (1989, p. 143). This has two important consequences regarding functions. First, a biological process or system would only be considered normal, no matter how rare, if it is capable of providing a solution to the demands of a given environment (1989, p. 144). Or, in Canguilhem's terms, it would only be normal if normative, i.e. capable of finding or creating those conditions in which it is viable. Here, he comes very close to Walsh's claim that functions have no intrinsic properties, they are not normal or abnormal in themselves, but only have properties in relation to an environment. Second, functions are not fixed by any underlying species-typical design, but are the result of habits: 'functional constants are habitual norms. What habit has made, habit unmakes and remakes' (1989, p. 169). Even if we take the species-level view, we are still led to the claim that functions are labile and plastic, insofar as they are dynamically related to environmental demands: 'for each function and set of functions there is a margin where the group or species capacity for adaptation comes into play' (1989, p. 170). While this 'functional plasticity' (1989, p. 174) is admittedly not something that can be changed at will, it would entail that Canguilhem can accommodate the claim that what has a function in one environment, could have a different function in a different environment as organisms adapt to the changed conditions. Walsh (1996) gives the example of a mouse with large ears which in a warm environment have the function of heat dissipation, whereas if transplanted to a wet environment in which the ears happen to resemble certain plants, they can be used to attract flies which the mouse eats as its primary food source. Their function is a function of the role they play in a given environment and it is the organism's functional plasticity that allows for this adaptability.

What I am calling Canguilhem's ecological account of functions can be seen quite well in the following passage regarding human norms[47]:

> In dealing with human norms we acknowledge that they are determined as an organism's possibilities for action in a social situation rather than as an organism's functions envisaged as a mechanism coupled with the physical environment. The form and functions of the human body are the expression not only of conditions imposed on

[47] Interestingly, this passage follows a discussion of Ryle's 1947 essay 'The Meaning of Normal', which Boorse also refers to. It is on the basis of Ryle's essay that Boorse criticizes the view that health is adaptation to an environment (1977). They draw completely opposite conclusions: for Boorse, the suggestion from Ryle that to understand normality we need to incorporate various aspects of the physical and social environment only shows that Ryle does not provide a properly value-free account, whereas for Canguilhem this essay provides further support for the claim that normality is not a purely value-free concept. As I will show in chapter 6, Boorse's focus on adaptation differs in important ways from Canguilhem's focus on *adaptability*.

> life by the environment but also of socially adopted modes of living in that environment (1989, p. 269).

This captures Canguilhem's central claim that living beings not only adapt to environments, but also construct environments according to their needs and values. As such, we cannot understand whether a given biological process has a function, especially in humans, without referring to these imposed and chosen environmental demands. One interesting consequence of referring to 'chosen' demands is that functional ascriptions need to go 'beyond the body' (Canguilhem 1989, p. 200) to incorporate social norms: 'we cannot clearly understand how the same man with the same organs feels normal or abnormal at different times in environments suited to man' unless we consider the human's 'technical plasticity and the desire to dominate the environment' (1989, p. 201). As we saw in the case of myopia, what is normal in one environment could be abnormal in another.

One rather important difference between Canguilhem and Walsh would be that Walsh's account of fitness is still statistical, resting on *average* individual fitness. Fitness is a property of populations, not of individual organisms[48]. In other words, while survival and reproduction are important biological and physiological processes, Canguilhem's concern is with how a trait allows/hinders a *given organism's* ability to establish a stable and flexible norm in its environment. As I will show, health and disease are properties of individual organisms and thus are not merely a matter of averages. This seems to imply that for Canguilhem a rare mutation only found in one organism, e.g. the morphological changes involved in the goat without forelegs or even one big-eared mouse that happens to find itself in a new environment, could very well play some role in that organism's life, helping it to survive, and its failure to perform this function could then be said to be pathological. Thus, he seems to narrow Walsh's indexing such that X is a function *for a given organism in its environment.* Thus whether or not an individual organism should be considered abnormal would depend not on social values but on the given organism, on what that variation entails in that environment for that organism. I will set aside possible problems for the moment so as to see how this colors his definition of disease.

Given what could be called his 'eco-organismic' relativity regarding biological norms, Canguilhem's view seems to be a modified naturalism. He defines disease as a 'reduction in the margin of tolerance for the environment's inconstancies' (1989, p. 199). In other words, an

[48] While Canguilhem's views about 'viability' are a bit vague, in chapter 6 I will explore the possibility of making them more precise through the concept of 'ecological fitness' which refers to organismic properties that aid survival in a given environment.

organism is diseased when its capacity to tolerate environmental variations and its ability to establish new norms have been reduced, leading to an inferior norm relative to that organism in its environment. The diseased organism is obliged to live in a 'shrunken milieu' (2008, p. 132), i.e. to have its range of possible behaviors and adaptive capacities limited. In this view, disease is not unnatural as it 'is still a norm of life but it is an inferior norm in the sense that it tolerates no deviation from the conditions in which it is valid, incapable as it is of changing itself into another norm' (1989, p. 183). This definition entails three aspects of disease.

First, rather than being merely the violation of a norm, it entails the *presence* of new physiological or structural norms that have a negative value as they constrict an organism's range of behaviors. Disease is not viewed as a privation or lack of organization, but a new organization, a 'positive, innovative experience in the living being' (1989, p. 186) that obliges the individual to behave differently. Oliver Sacks has similarly captured the problem of reducing disease to mere deviations when he argues that 'disease is never a mere loss or excess … there is always a reaction, on the part of the affected organism or individual, to restore, to replace, to compensate for and to preserve its identity, however strange the means may be' (1998, p. 6). Disease is lived as an inferior norm since it entails a hindrance or limitation on the comportment of the organism in relation to its environment, but it also expresses the organism's ability to find new ways of meeting environmental demands that medical treatments need to be aware of[49].

Second, the qualification of disease rests on *organismic* norms, implying that the individual organism should be compared to itself, at different times and in different environments. As each organism is different, even if only slightly, what is abnormal for one need not apply to others depending on their unique physiology and selected or imposed environmental demands. While comparing two organisms, one with a trait and one without it, might be heuristically helpful, the comparison alone is not decisive. 'It is the individual who is the judge of this transformation [from normal to pathological] because it is he who suffers from it from the very moment he feels inferior to the tasks which the new situation imposes upon him' (Canguilhem 1989, p. 182). He thus starts from the claim that the value or viability

[49] 'Who would maintain that hypertension is a simple increase in the physiological arterial pressure and neglect the profound alteration in the structure and function of the vital organs (heart and blood vessels, kidneys, lungs), an alteration such that it constitutes a new way of life for the organism, new behavior which prudent therapy must take into account by not treating the tension at an unpropitious moment in order to bring it back to the norm?' (Canguilhem 1989, p. 84). In other words, 'for the individual, disease is a new life, characterized by new physiological constants and new mechanisms for obtaining apparently unchanged results' (1989, p. 188).

of an individual organism (or a function), i.e. whether or not it will survive (or contribute to survival), is not determined *a priori* by its relation to some transcendent Platonic ideal or species-typical norm, but according to the organism's contingent ability to adapt to a particular environment (2008, p. 125). While this organismic relativity seems to erase the boundary between health and disease, Canguilhem argues that even if we accept that 'from one individual to the next the relativity of the normal is the rule' (2008, p. 130), this does not erase the absolute and qualitative difference between these states for the individual organism.

Third, these two aspects are understood in relation to the organism's experienced *mode of life*, i.e. its actions, needs, and preferences as expressed in a changing environment. By referring to modes of life, we can address the possible objection that Canguilhem's account would imply a normative definition of health and disease in terms of desirability. While he does appeal to the 'subjective' elements of disease (1989, p. 229), this need not imply that he is assuming some form of phenomenological or transcendental subjectivity that serves as the condition of possibility or foundation for our understanding of biological norms (e.g. Merleau-Ponty 1963, p. 202). Nor is he appealing to first-person experience to complement naturalism (e.g. Carel 2008). Referring to 'subjectivity' simply entails seeing the (human) organism as a center of action by which it structures its milieu according to its needs and values as a living being[50]. Insofar as humans are capable of representing their experience of disease to themselves (Canguilhem 2012, p. 39) it is not as transcendental subjects, but as norm-establishing organisms. As such, without appealing to desirability, the distinction between health and disease can still be determined relative to an organism's activities in a particular milieu. For example, even the diagnosis of sterility as a disease cannot be based solely on physiological determinations, since it need only be considered abnormal for an individual who is trying to reproduce (irrespective of whether they subjectively value such reproduction). Regardless of the supposed 'demands' of our genes, reproduction is a choice, not a necessity. Similarly, while celiac disease or lactose intolerance prevents one from eating certain foods, the judgment that the lack of certain enzymes entails a dysfunction seems unwarranted in gluten-free or dairy-free environments, i.e. where the *practice* of consuming these foods is absent. In both cases, the

[50] 'Car il y a dans la connaissance de la vie un centre de référence non décisoire, un centre de référence que l'on pourrait dire absolu. Le vivant est précisément un centre de référence. Ce n'est pas parce que je suis pensant, ce n'est pas parce que je suis sujet, au sens transcendantal [sic] du terme, c'est parce que je suis vivant que je dois chercher dans la vie la référence de la vie' (1985, p. 352). For more on Canguilhem's non-transcendental account of subjectivity, see Badiou's insightful essay 'Is there a theory of the subject in Georges Canguilhem?' (1998).

judgment that such conditions are pathological would be more accurate by incorporating the organism's environment and behaviors: its mode of life.

To summarize, disease is thus a disruption of one's physiological or behavioral norms, regardless of whether these are based on desires. Mirroring Spinoza's critique of teleology (2000), we could argue that health and disease are not desired or avoided in relation to what is objectively good (as an ideal), but their value is based on the organism's activity amidst the changing conditions of its life. Even the blind man, Spinoza reminds us (2002), is only 'deprived' of sight when compared to others, but in relation his own norms, he cannot lack what he does not have. Thus, it is neither the normalizing scientist (via abstract norms) nor society who dictates which values are positive or negative to the living being based on quantification, abstraction, and exclusion[51]. The line between health and disease is decidedly not a mere academic affair (Boorse, 1977, p. 559): it is relative to the concrete organism in its particular environment that such judgments should be made.

5. Conclusion: From Environmental to Social Relativity?

Following this analysis, it seems accurate to argue that Canguilhem's eco-organismic relativity of biological norms contains an implicit ecological account of functions and this is clearly at work in his analysis of anomalies and abnormalities. I presented evidence and arguments in favor of this view. Moreover, I also argued that this view solves many of the problems that Boorse's biostatistical account of disease is confronted with. There are, however, two problems that remain: one minor and one serious.

First, if this description of Canguilhem is accurate, it seems that he might be open to the criticism that by relativizing functions to individual organisms, this would allow nearly anything to be considered a function, which might undermine the ability to distinguish accidents from functions and also functions from dysfunctions. One way of responding would be to take up the insights from the first chapter such that Canguilhem's approach begins with the individual organism, not with the group or species. As such, because normality is determined by the organism, this would only pose a problem if we were after necessary and sufficient conditions. As this is not the case, this is not a fatal problem. There is, however, a bigger problem facing his account: social norms.

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[51] 'One does not scientifically dictate norms to life' (Canguilhem 1989, p. 226).

Many species are social species, our species being one of them. This means that we rely on other human beings for teaching us what to eat and what not, for healing us when we are sick and for consoling us when we are feeling sad or lonely. An interesting consequence is that the human environment is – to a large extent – a social environment, both because it was constructed together with other individuals of our species, and because other people are part of the environment. Now, if health and disease are relative to the environment, as Canguilhem claims, then one can expect that health and disease in a social species like ours are, in part, relative to the social environment.

To some extent, this point was already underscored by the example of dyslexia: in environments where reading and writing are expected and important for the well-being and overall functioning of an individual, dyslexia can be a disease, whereas the condition is not pathological in illiterate societies. Yet, it seems that there are examples of 'social relativity' that challenge Canguilhem's account, e.g. homosexuality. Individuals who prefer to have sex with individuals of their own sex have been treated differently by different cultures. In Western Europe prejudice against homosexuality and homosexuals was almost endemic for much of the last millennium. Even worse, during that period many homosexuals were incarcerated for their homosexuality and it was not uncommon to execute so-called 'sodomites' (Gerard & Hekma 1989). Luckily, Western Europe has witnessed a dramatic change in sexual values to such a degree that sexual discrimination has become illegal in many countries. In this case, the emphasis on the environmental relativity of disease seems to lead to the judgment that homosexuality is a disease in some social environments and is normal/healthy in other environments. By defining disease relative to an environment, is Canguilhem incapable of preventing the relativistic claims that disease is what is deemed as deviant according to some local standards and that health is merely 'adjustment to society' (Woolfolk 1999)?

Canguilhem's environmental relativity seems to lead to the conclusion that homosexuality was a disease during the era that it was heavily stigmatized, and stopped being a disease after it was (widely) accepted. Yet, for several reasons this might be easier to accept than many would expect. For instance, it is clear that calling homosexuality a disease (or a sin) may convince some homosexual individuals that they are suffering from a disease, especially if they cannot adapt their desires and behaviors to the very strict sexual norms of their society. Furthermore, the social nature of humans also implies that humans are very good at internalizing social norms. If the homosexual individual has internalized the anti-gay norms, he

is bound to feel extremely guilty for his desires, or he may feel extremely disgusted about himself every time he acts upon his desires. You do not have to be a Freudian to see that this intra-psychic conflict can lead to serious psychiatric problems. These first two points might serve as a lubricant for accepting the view that homosexuality is a disease in some societies (and not in others!). However, they are far from compelling since the real problem seems to be that, according to a relational account, one has to claim that homosexuality is a disease in some homophobic societies *even when the homosexual individual does not see his sexual orientation as a disease and even if there is no intra-psychic conflict within the homosexual individual.* In such a context, the judgment would be based on the threat of being ostracized, the continual policing of one's behavior, or the general social pressures to conform that characterize that environment.

There are two reasons for why this could be an acceptable view. First, saying that homosexuality is a disease in some environments does not necessary reflect a moral condemnation of homosexuality. To be perfectly clear about this, one can condemn homophobia while still arguing that a homophobic environment could make homosexuality a diseased condition. Secondly, emphasizing the environmental relativity of normality and disease also entails that therapeutic interventions and prophylactic measures can focus on the interaction between individual and environment, but also *solely* on the individual or *solely* on the environment. The case of homosexuality seems to be an example where the best results are to be expected from changes in the social environment. This idea will be further explored in the last chapter of this dissertation.

There is another aspect to this, however, which was pointed out above in terms of how Canguilhem's account differs from Walsh's by not appealing to average individual fitness. If we begin from the individual in its environment, then the question is not merely one of environmental relativity such that we can bracket the homosexual's perception and experience. In other words, it is not merely relative to the society's homophobic norms, but also relative to what these norms entail for a given individual. If we take Canguilhem's claim seriously that 'from one individual to the next the relativity of the normal is the rule' (2008, p. 130), then the following argument seems possible. Similarly to how a dyslexic individual who does not value reading need not be considered to have a disease even in a literate society, a homosexual individual who does not seek to conform to his heteronormative society need not be considered pathological. If the individual does not share the society's values and practices, why shouldn't

we be justified in calling the individual 'normal'? It is not the society, but the individual who is the judge of the line between the normal and the pathological.

This chapter raises the following questions. Is this account of health and disease even biologically tenable? Why should we appeal to individual 'experience' or behaviors when trying to understand these concepts? While this might seem obvious, much of what we currently understand about the norms of health and disease reflects population-level considerations coming from epidemiology. While Canguilhem focuses only on the level of the organism, viewed as a functionally integrated whole relative to its environment, how are we to understand these social and population-level dynamics? If we are to incorporate the role of social norms in disease judgments, then why not go beyond the individual organism? The next two chapters will take up these questions and their implications for Canguilhem's philosophy.

Chapter Three

Beyond the Organism? Dissecting Giroux's Epidemiological Critique of Canguilhem

> Of course, one cannot transpose to whole societies what happens psychologically in a real sense in the individual, and this includes mental illness and stupidity, but still one might speak repeatedly today of a "social imitation of mental defects".
>
> Robert Musil, *Precision and Soul*

While many argue that Canguilhem's insights regarding health and disease seem germane to key issues in the philosophy of biomedicine, this claim is not universally shared. For example, in an essay considering the thesis Canguilhem put forth in the 1943 edition of *The Normal and the Pathological* the philosopher of biology Michel Morange has argued that this thesis is 'so strong that it is untenable in its consequences[52]' (Morange 2008b, p. 156). The main thesis he is referring to is that there is no disease without an experiencing subject: 'only the organism can be sick' (2008b, p. 157). The claim that such a thesis is untenable, due to recent changes in both medicine and biology, is a rather damning critique to anyone currently trying to defend Canguilhem's views. In her recent work regarding the epistemology of epidemiology, Élodie Giroux has fueled the fire of such a critique (2008; 2010; 2011). She asks whether an appeal to population-level factors, as is done in epidemiology, problematizes Canguilhem's organism-centered view of biology and the claim that health judgments *only* pertain to individuals. If so, does this allow for a concept of 'health' at the population level and thereby further demonstrate the limitations of Canguilhem's thesis?

This chapter aims to dissect and assess these critiques by analyzing not only Canguilhem's 1943 thesis but also the full range of his thought. In the first section, after briefly laying out Giroux's critique I will provide a detailed analysis of the concept of individuality in Canguilhem's philosophy and how it is used to clarify health and disease. While Giroux is right to point out certain limitations with his approach, she seems to misrepresent his claims. In the second section, I will ask whether her critique via epidemiology adequately addresses the many ways in which Canguilhem appeals to environmental factors to rethink medical judgments. More specifically, I will show that, far from ignoring population-level factors, Canguilhem's ecological analysis of health and disease is replete with references to intergroup, intercultural,

[52] Quotations from Morange and Giroux are my translations from the original French.

and international comparisons, each pointing to the problem of individuality in making medical judgments. In the final section, I will ask whether Giroux's critique commits a category error of applying organism-level properties to populations. What is meant by the concept of 'population health'? While Giroux's claims are a bit problematic in themselves, they will serve as a nice heuristic to help clarify Canguilhem's ideas.

The consequences of this will be further developed in the next chapter where I show how it is far from evident that the organism has lost its place in evolutionary theory. Contrary to Giroux's (and Morange's) suggestion that many aspects of biology force us to question Canguilhem's organism-centered approach, a strong argument can be made for placing the organism back in the center of evolutionary theory. If so, then far from being untenable, Canguilhem's views might be more relevant than ever.

1. Giroux's Multifaceted Critique and Canguilhem's Individual=Organism

In her 2008 essay, 'N'y a-t-il de santé que de l'individu? Un point de vue épidémiologique sur les thèses de Canguilhem' and her 2010 text, *Après Canguilhem: définir la santé et la maladie*, Giroux assesses what she sees as Canguilhem's attempt to find a biological basis for the individuality of health and disease by appealing to the role of individuality in evolutionary theory. In her reading of Canguilhem, she claims that in order for him to overcome the positivist or reductionist view that the pathological state is nothing more than a quantitative deviation from the normal state, he has to appeal to the individual 'as a whole' as being the source of vital norms (Giroux 2008, p. 174). In other words, it is only on the level of the lived experience of the whole organism in relation to its environment that one can properly distinguish between the norms of health and disease. Furthermore, only the organism can be properly called an individual since only the organism functions as a 'true whole' (2008, p. 175). Canguilhem seems to claim, then, that without the kind of self-regulating unity that an organism possesses, whole societies, especially human ones, cannot be considered *individuals*. From here, she argues that Darwin's idea that natural selection works on those individuals whose traits are beneficial for survival and reproduction allowed Canguilhem to see biological normativity as pertaining primarily to the individual[53]. Thus, since only the individual

[53] 'That the individual organism is the level of organization upon which natural selection acts allows Canguilhem to establish the idea of a close link, even an identity, between normativity and individuality' (Giroux 2008, p. 176,

organism is a true whole, and only the whole can be deemed healthy or sick, an appeal to the biological importance of the individual supports the claim that only individuals can be healthy or sick.

After this explication, she develops a multifaceted critique of Canguilhem based on at least three main points. First, she argues that since the 1970s, evolutionary biology has undergone a shift in how it understands natural selection, such that the 'individual organism loses its centrality that it had at first sight' (2008, p. 178). This centrality is called into question by the levels of selection debate concerning what exactly is being selected in evolution. In this debate, some have claimed that a trait will only be selected if beneficial for genes, some have argued for the selection of group-level properties, and others have argued that selection occurs on multiple levels (see Okasha 2006b). For example, philosopher and biologist Massimo Pigliucci argues that

> there is no reason to ontologically favor the individual level (other than, historically, that was the level referred to by Darwin). … multiple causality is well known in both biology and everyday life, and individual-level selective explanations should not win by default just because they are the ones that we are most used to invoking (2008a, p. 80).

Second, parallel with this change in evolutionary theory, Giroux points to the claim that the concept of *biological individuality* is no longer simply linked to organisms, but can refer to various levels of biological systems: from genes, to cells, to species, populations and possibly entire ecosystems. While Canguilhem reserved the concept of individual for cells and organisms, Giroux suggests that there are biological arguments for extending it to populations as a whole.

Finally, as a result of these changes in biological theory, questions concerning the nature of health also appear to be challenged. Canguilhem's stress on the individuality of health is troubled by epidemiological studies that reveal important factors for health that are only visible on the level of populations, e.g. the cause of a disease can often only be explained by comparing two populations, revealing properties that the study of individuals occludes (Rose 1985). For Giroux, this is not only epistemologically important, but also ontologically important. On the one hand, biology seems to have displaced the individual from its once central explanatory position in evolutionary theory and, on the other hand, epidemiology

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my translation). At the moment, I am simply presenting her reading of Canguilhem. I will assess its accuracy shortly.

allows for properties such as 'health' to be applicable to whole populations (Giroux 2011). With these claims Giroux calls for a rethinking of the biological basis for judgments regarding health and disease that departs from Canguilhem's stress on individuality.

Do these critiques, however, oversimplify what an appeal to the 'whole' organism entails and thereby miss what is at stake in Canguilhem's work? While Canguilhem does appeal to biological individuality as a 'whole' so as to better distinguish health from disease, what does this 'whole' entail and how is it related to the concept of 'organism'? In what follows, I will mainly focus on explicating Canguilhem's ideas and their relation to the issue of population health. I will discuss the levels of selection debate in the next chapter. To better understand what Canguilhem had in mind regarding the organism 'as a whole'[54], I will first briefly discuss the origin of this idea in the early twentieth-century neurologist Kurt Goldstein by whom Canguilhem was deeply influenced[55].

1.1. Goldstein's Methodological Holism

After studying medicine in Germany under the anatomist Ludwig Edinger and clinician Carl Wernicke, Kurt Goldstein put his studies to the test as he worked as a neurologist treating brain injured soldiers during World War I. If this provided a situation for witnessing the concrete problems of pathology, his collaboration with Gestalt psychologist Adhémar Gelb, with whom he founded an institute for brain injured patients, allowed him to observe how the effects of such injuries were not reducible to localized lesions, but entailed a global alteration of behavior. Following his clinical observations, Goldstein wrote his main work *The Organism*[56] to show that the prevailing atomistic theories of organisms, such as the rather influential reflex theory developed in the early twentieth century, were misguided as they did not take into account the conditions of how their claims were made and thereby distorted the facts.

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[54] For the moment, I have not yet dealt with the distinction between biological individual and organism and so am using the concepts interchangeably. As I will show below, while Canguilhem tends to use the concept of 'individual', what he seems to have in mind is 'individual organism'. See Wolfe (2010) for an interesting historical and philosophical account of the concept of the organism. While Wolfe is right to point out certain metaphysical interpretations of Canguilhem's approach, I depart from Wolfe's seeming assumption that such interpretations can be analyzed apart from their scientific descriptions.

[55] For more on this influence see Le Blanc (1998), Lecourt (1975, 2008), and Roudinesco (2008).

[56] After being expelled from Germany under the strictures of the Nazis in 1934 and taking refuge in Holland, Goldstein dictated this text during a brief period of only a few weeks. While Goldstein was not a high-level dissident, these ideological circumstances are not insignificant when thinking about the implications of referencing this text in France in the early 1940s. For more on the social and political circumstances surrounding Goldstein see the foreword to the English version by Oliver Sacks (1995, pp. 7-14), Harrington (1996), and Noppeney (2001).

According to these theories, an organism could be fully explained in terms of its isolable parts precisely because, under strict experimental conditions, functions could be localized and reduced to consistent physiological reactions (Goldstein 1995, p. 69). Consequently, the organism was taken to be merely the sum of these mechanistic reactions to stimuli as seen through physiological analysis.

However, Goldstein argued that this reductionism was made possible within the artificial and restrictive environment of the laboratory. If experiments showed some regularity it was because it was imposed on the organism, rather than coming from any essential properties, and as such represented a form of diminished or pathological behavior. Even under such conditions, the organism reacted with much variety and plasticity that was problematic for the reflex theory: the same individual having varied responses to the same stimuli, the same response returning with differing stimuli, etc. Contrary to this view, Goldstein claimed that the organism is better understood as an ordered whole that tries to maintain this order as it 'comes to terms with' its environment (1995, p. 101), implying that the functioning of the whole cannot simply be reduced to its parts. For example, the effects of brain lesions cannot be understood only in terms of damage to a specific part of the brain, since there are many factors that determine whether a given symptom will appear following a localized injury, such as how the injury relates to the rest of the brain or to the individual's activity as a whole (1995, p. 207).

Moreover, while there are many similarities among organisms regarding basic physiology, what is normal for one individual could very well be intolerable for another depending on their different circumstances, demands, and needs, even the artificial demands of the laboratory. Rather than comparing individuals to a super-individual norm, normality depends on the conditions that are relevant relative to the individual (Goldstein 1995, pp. 163, 329). Conversely, disease is not merely a deviation from normal functioning, but entails a shock to the organism as a whole, a shrinking of its milieu, implying that behavior that was once adequate in a given situation is no longer so and requires a new norm to be established (1995, p. 328). This is witnessed, for example, when patients with hemiplegia (limb paralysis) are forced to learn to write with the opposite hand, when an animal reorganizes its gait following an amputation, or when the visually impaired attempt to recognize objects by behaviors that would normally be uncomfortable. Goldstein's holistic approach, then, attempts to refute atomistic or mechanistic interpretations of the organism not on philosophical, but on empirical, clinical grounds.

His concern with the 'organism as a whole', then, should be understood as an attempt to develop a proper scientific method for physiology such that 'no phenomenon should be considered without reference to the organism concerned and to the situation in which it appears' (1995, p. 40). Rather than assuming that organismic behavior is best understood by isolating parts and subjecting them to strictly controlled stimuli, Goldstein argued that any such part and seemingly localized reaction to stimuli that is described by reflex theory presupposes the background of the whole organism: the demands currently placed on the organism and the current state of adaptation to these demands (1995, pp. 99, 101); whether the organism is under a state of stress or subjected to unnatural conditions; what the other parts of the organism are doing in relation to the localized part; the state of the organism's development, etc. In order to determine whether a given behavior or the functioning of a part is normal or abnormal, it is necessary to refer them to these background considerations that are constitutive for the individual organism (1995, p. 306). A part's atomized functioning, be it organs, neurons, or genes, is thus not in itself sufficient to explain and differentiate health and disease, since this determination depends on what the phenomenon means for rest of the organism (1995, pp. 173-183, 347).

One further nuance of this theory is that these appeals to the 'whole' are not only with regards to the spatial organization of the organism, but also to its temporal state. For example, the distinction between normality and pathology, while relative to the individual in its present condition and relation to its milieu, does not prevent the ability to consider those conditions which have not yet presented any symptoms or which are quite possibly asymptomatic, such as the early stages of cancer or cirrhosis of the liver. By stressing the 'whole' organism, this entails that the organism's future state is also to be considered (Goldstein 1995, p. 332), such that even if a phenomenon has not yet presented itself, insofar as it can disrupt a future state we can understand why it will be termed pathological: a disturbance 'can also exist objectively without the person becoming subjectively conscious of it' (1995, p. 329). This is important to stress since Giroux (2010, p. 34) wrongly criticizes Canguilhem, and by extension Goldstein, for placing too much importance on disease as a disruption of the *present* state of the organism[57].

[57] Nikolas Rose also criticizes Canguilhem's stress on disease as a *present* diminution of normativity for being ill-suited to deal with recent shifts in biomedicine towards risk and susceptibility that aim to see disease where there are not yet any symptoms (2007b, p. 85). As with Giroux's critique, this misses two important claims. First, Canguilhem claims (following Leriche) that 'If, today, the physician's knowledge of disease can anticipate the sick man's experience of it, it is because at one time this experience gave rise to, summoned up, that knowledge' (Canguilhem 1989, p. 93). It is because some disease was brought to the clinic that we now know to intervene

This holism, then, need not be understood as an 'obscurantist holism', to use a phrase by biologist Richard Lewontin (2001), by which everything is connected to everything else such that nothing can be held constant for measurement and thereby no knowledge can be obtained. Rather, it is a stress on the fact that biological parts do not function indifferently to other parts[58] and this functioning is relative to how the organism structures its environment (Goldstein 1995, p. 85), all of which is crucial for determining whether a given symptom will lead to pathological behavior. In fact, Goldstein criticizes the theoretical biologist Ludwig von Uexküll for having reduced the organism's activity to its many external relations with the environment, missing how an 'environment always presupposes a given organism' around which the environment is structured (1995, p. 85). Canguilhem comments on this problem as follows:

> if one is unwilling to distinguish the living from its environment, all research into relations becomes in a sense impossible. Determinism disappears and is replaced by reciprocal penetration, and taking the whole into consideration kills knowledge. For knowledge to remain possible, within this organism-environment totality there must appear a nonconventional center around which a range of relations opens out (2008, p. 177, n. 29).

By appealing to the organism as this center of activity whose 'preferred behaviors' both shape and are shaped by its environment, Goldstein can claim that 'the individual is the measure of his own normality' (1995, p. 329f) without undermining the knowledge gained through scientific analyses.

From this discussion it should be clear that Goldstein's description of the 'whole organism' is an attempt to account for the epistemological problems that variability and individuality pose for understanding health and disease. As such, it is not because the organism is a whole in some essentialist or Platonic sense that all of its physiological and environmental relations matter. If this were the case then the environment would be secondary or possibly inconsequential for understanding the organism's behavior, as is partly the case in Boorse. Rather, it is because an organism's individuality comprises a multiplicity of causal chains, to borrow another phrase from Lewontin (2001), that it demands this holistic methodology. For

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before the symptoms appear. Second, since disease involves a relation to the environment, he argues that some biochemical diseases 'often remain hidden as nonactivated tendencies' that are only activated in the right environment (Canguilhem 1989, p. 281f).

[58] A view that is clearly indebted to Kant (1987).

Goldstein, *it is not individuality that clarifies holism, but holism, understood as a method of appealing to the totality of biologically significant relations, that clarifies the individuality of biological norms.* As we will now see, it is this stress on how the totality of relations clarifies biological individuality that also helps Canguilhem to support his descriptions of living beings.

1.2. Canguilhem, Holism, and the Individuality of Organisms

It is quite evident that Canguilhem relies heavily on Goldstein, even if his studies of medicine and biology allow him to further develop the arguments[59], in part by accounting for the historical nature of biological norms. One can find many examples of this influence throughout Canguilhem's three main works on biology and medicine: *The Normal and the Pathological*, *Knowledge of Life*, and *Writings on Medicine*. This can be seen, for example, when Canguilhem argues that disease, for all living beings, is to be understood as an event involving the 'whole organism' (1989, pp. 80, 223, 224), and for humans this also includes a reference to consciousness as part of the 'indivisible totality of behavior' (1989, p. 88). Or when he claims that in order to differentiate health from disease, we should look to the 'total comportment', the 'totality of the organism', or the organism 'in its entirety' (2008, pp. 129-131). It is this totality that is qualitatively reduced in disease, when the organism is obliged to live in a 'shrunken milieu'. These ideas come directly from Goldstein.

In Canguilhem, we can establish two somewhat distinct claims regarding this 'holism': one epistemological or methodological, the other ontological[60]. On the one hand, he shares Goldstein's methodological holism in that biological processes, from parts of organisms to whole organisms, need to be situated in their relevant milieu to be properly understood. 'As a general rule, analytically obtained knowledge can influence biological thought only when it is informed by reference to an organic existence grasped in its totality' (Canguilhem 2008, p. xx). This totality refers to all the relations affecting the inner milieu of the organism and the influences coming from its external milieu, from the molecular to the ecological level (2012, p. 48). For example, genetic processes need to be situated in relation to other genes and the cellular system in which they occur, cells being situated in the organ or larger physiological

[59] For a thorough description of the concept of individuality in Canguilhem see Gayon (1998).
[60] Wolfe (n.d.) stresses this equivocation in Canguilhem, but takes it in a more critical direction by asking whether the ontological aspect leads Canguilhem into problematic metaphysical claims, or what he calls 'biochauvinism'. As his critique misses the empirical aspects of Canguilhem's position, it is not very convincing.

systems, to the whole organism dynamically interacting with its environment, etc. It is relative to a whole that the parts can be best understood. Lewontin argues for a similar methodological 'holism' in biology:

> For biological systems, because of the hierarchy of functions and because of the multiple intersecting causal pathways, the determination of parts is made only after the appropriate "whole" is defined. … In biology we cannot escape from the dialectical relation between parts and wholes (2001, pp. 79, 82).

It might thus be more accurate to argue that Canguilhem's appeal to the whole organism is not done simply to reject reductionism (i.e. explaining the whole by means of the parts), but is meant to show how the methodology of reductionism presupposes the dynamic relation between the various parts of organisms and their relevant functional wholes. This would explain Canguilhem's interest in Goldstein's critique of von Uexküll that was mentioned above.

On the other hand, this 'holism' in Canguilhem is not merely epistemological, requiring that the parts of organisms are understood against a background of interactions with other parts, but also appears to entail an ontological claim. What is important here is that this is not justified based on metaphysical grounds, but on empirical grounds, e.g. findings in biology, physiology, and pathology. He argues that based on the self-regulating capacities of organisms, the interrelatedness of physiological processes, and their non-indifferent relations vis-à-vis their environment, not only does the organism function as a whole, but it can only live 'as a whole' (2012, p. 72). 'This is made possible', he adds, 'by the existence in the organism of a set [*ensemble*] of apparatuses or mechanisms of regulation whose effect consists precisely in the maintenance of this integrity, in the persistence of the organism as a whole' (2012, p. 72). Examples of such systemic regulation include respiratory movements, the homeostatic regulation of the level of water and chemicals that allow for cellular and organ functioning, thermoregulation, the maintenance of nitrogen equilibrium, as well as the regulation of embryonic development and immunological reactions to and recovering from lesions or infections, etc. (2012, p. 73; 1989, p. 207). It is the existence of such systemic processes that allows Canguilhem, particularly in his later work, to argue that in an organism the 'totality' is 'present to it and to all its parts' (2012, p. 76). In other words, the whole is the condition of possibility of the parts.

For Canguilhem, then, the organism can be understood as a whole because (1) the properties and functioning of the parts are influenced by the whole to which they belong such

that it is their relation to the whole that determines their function, and (2) the organism exhibits systemic self-regulating processes that dynamically interact with changes in the environment: 'Living systems are open, non-equilibrium systems that maintain their organization both *because* they are open to the external world and *in spite of* being open to the external world' (1988a, p. 141). An appeal to the 'whole' is an appeal to the fact that organisms exhibit some degree of closure/autonomy regarding their relation to the environment, but this is never total since it is precisely this relation that will determine the norms of a given organism. This ontological 'whole' thus simply implies relationality and organized complexity[61]. The need for 'organismic' explanations, putting 'the total organism and its behavior again into the forefront' (1989, p. 219), ultimately reflects these two aspects of Canguilhem's holism: understanding biological processes in terms of whole-part relations and studying the systemic organizational properties as properties in their own right, as the conditions of possibility of the living being.

After clarifying his holism, two further questions need to be answered so as to better assess Giroux's critique. How does this holism clarify 'biological individuality' and what is at stake when we move to the level of societies?

Canguilhem's holism pertains to individuality such that individuality 'does not describe a being but a relation' (Gayon 1998, p. 319). In his essay on the history of cell theory, Canguilhem briefly defines the concept of the individual as 'what cannot be further fragmented without losing its proper characteristics. It is a minimum of being. Yet no being is in itself a minimum. In itself, the individual necessarily presupposes its relation to a greater being', a 'background of continuity against which its discontinuity stands out' (Canguilhem 2008, p. 49). He adds that individuality is 'a term in a relation', the other term being the milieu (2008, pp. 49, 50). What this definition suggests is that when trying to understand biological individuality, we should keep in mind that living beings do not function as a mere collection of parts (since this totality is constantly being renewed), nor do the parts themselves function indifferently to their relation to the whole organism. An organism's individuality consists in a unique totality of integrated causal relations that constitute it and are constituted by it: it is its relationality that makes it an indivisible being.

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[61] As I will show in chapters 4 and 6, Canguilhem's views come quite close to what is now called 'complexity theory' in terms of the adaptability of living systems (Davis & Sumara 2010, p. 42). Moreover, Morange (2000) argues that while Canguilhem might have overestimated the importance of cybernetics for understanding the then contemporary views in biology, his appeal to holism remains pertinent in light of various findings in biochemistry, genetics and network theory.

Moreover, the individual organism, functioning as a whole, establishes itself as a center around which the milieu is constructed in relation to its needs: 'To live is to radiate; it is to organize the milieu from and around a center of reference, which cannot itself be referred to without losing its original meaning' (Canguilhem 2008, p. 114). In a famous essay on 'The Organism as the Subject and Object of Evolution', Lewontin[62] expresses the same idea as follows:

> Just as there is no organism without an environment, so there is no environment without an organism. … The organism is, in part, made by the interaction of the genes and the environment, but the organism makes its environment and so again participates in its own construction. Finally, the organism, as it develops, constructs an environment that is a condition of its survival and reproduction, setting the conditions for natural selection (1985, pp. 99, 105f)[63].

A center is only a center in relation to what is centered, just as an organism's individuality is only determined in relation to what it organizes: its milieu. As the two cannot be separated, holism clarifies biological individuality[64].

There is, however, one complication to this, which is that Canguilhem only seems to have considered cells[65] and 'organisms' to be the two main candidates for being called individuals since they alone are organized or unified as a whole in relation to their milieu (Gayon 1998). While a population or society of individuals has a kind of organization and does have a relation to a milieu, it does not have the same kind of self-regulating organization observed in living beings and therefore is not an individual, according to Canguilhem (2012, p. 77). As Giroux points out (2008, p. 175), it is here that Canguilhem equivocates between 'biological individuals' and 'organisms'. Canguilhem only describes cells and organisms as individuals and thereby seems to prevent any extension of biological individuality to levels

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[62] This essay, written by Lewontin, first appeared in 1983 in the journal *Scientia* and then was republished in a book of essays written with Richard Levins in 1985. My references are to the 1985 publication.

[63] In a later development of this same idea, one finds a passage that could easily appear in a book by Goldstein or Canguilhem: 'An *environment* is something that surrounds or encircles, but for there to be a surrounding there must be something at the center to be surrounded. The environment of an organism is the penumbra of external conditions that are relevant to it because it has effective interactions with those aspects of the outer world' (Lewontin 2001, p. 48f).

[64] His position could also be described as stressing the relation between particularity (spatio-temporally located, material instantiations) and individuality (unique biological information and ontogenetic history). Cf. Ruiz-Mirazo et al. (2000).

[65] Since only the organism 'as a whole' can be sick, a cell, such as a white blood cell, if considered as a living organism 'in a defense and reaction situation vis-à-vis an environment' could be considered an individual and thus could legitimately be called sick (Canguilhem 1989, p. 224). Part or whole thus depends partly on perspective.

above the organism. However, while 'organism' usually denotes a causally integrated whole, 'individual' need not, thereby allowing the latter concept to be applied to various levels, such as a species (Wilson 1999, p. 62). As such, all organisms are individuals, but not all individuals are organisms[66].

While it seems that Canguilhem was short-sighted here in not distinguishing individuals and organisms, does this problem capture what was really at stake for Canguilhem and can his insights regarding individuality be retained? In fact, in the main essay where Canguilhem tackles the problem of understanding the organization involved in societies, 'The Problem of Regulation in the Organism and in Society', his concern is with the 'permanent comparison of society *to an organism*' (2012, p. 68; emphasis added). While he traces this idea of 'organicism', typically associated with August Comte, all the way back to the Greeks, his main target in this essay is Walton Cannon's 1932 book: *The Wisdom of the Body*. There, Cannon drew an analogy between an organism's homeostatic mechanisms and some sort of 'social homeostasis' established by the body politic that reacts to social disorder (Canguilhem 2012, p. 75). Canguilhem argued that, with *human* societies, the complexities of human behavior and social structures, as well as the nearly continual presence of social unrest and crisis, make referring to any society as an integrated whole rather difficult (2012, p. 71). Canguilhem is thus not concerned with the claim that societies or populations could be individuated by means of their having norms or causal properties, as this is a trivial claim. Instead he is rejecting the claim that societies can be viewed as self-regulating *organisms*[67].

Thus, while Canguilhem can be criticized for having problematically conflated the concepts of individual and organism, the focus of his analysis should be specified. Moreover, even for those biologists open to viewing populations or species as 'units of selection', the idea that such populations could be 'self-regulating' is considered highly problematic, both epistemologically and empirically (Lewontin 1970, p. 13). If some organisms can be defined as 'populations', then Giroux could be justified, at least for those organisms. It is true that many, if not all, organisms involve some symbiotic relationship with other organisms, e.g. with bacteria, and that some organisms seem best individuated on the level of a community (cf. Janzen 1977), but it is another claim entirely that *human* societies are organisms. While Giroux is correct to

[66] For more recent accounts of biological individuality see Clarke (2013) and Bouchard & Huneman (2013).
[67] Canguilhem has a lengthier critique of Comte's organicism in the second part of *The Normal and the Pathological* (1989, pp. 250-257). See also the translators' introduction to *Writings on Medicine* for a good discussion of the political nature of Canguilhem's critique of social 'self-regulation' (2012, pp. 18-22).

point out that populations can also be individuals (e.g. Millstein 2009), if she is to truly challenge Canguilhem, it is this latter claim that she has to substantiate. I will return to this issue in the next chapter.

What was at stake, then, in Canguilhem's various descriptions of biological individuality was not how all individuals are organisms, but *what constitutes organismic individuality and how this individuality complicates biological and medical norms.* Following Goldstein, his holism helps to show how individuality is inescapable, both epistemologically and ontologically: as organisms are complex systems interacting with changing environments, what will be normal for one, need not be normal for another. The contingencies of life make every organism unique, and what it is capable of in terms of its normativity – its ability to create new norms – is determined by the multiplicity of forces that never cease to act upon it and issue from it throughout its life. While his holism might seem to run counter to how biological knowledge is produced, Canguilhem's point is that it is relative to this systemic self-organization and self-maintenance, properties that largely distinguish biological entities from physical ones, that concepts like normality, health, and disease take on meaning (1988a, p. 143). To this end, his approach was meant to illustrate that geographical, biological and social factors thoroughly shape the individuality of organisms[68], especially humans, and that, as a result, individuality remains a problem for medical judgment. In the next section I will show that it is by situating organisms in their complex environments that his approach is actually more open to various levels of analysis than Giroux suggests.

2. Contextualizing Disease and the Problem of Experience

After clarifying some of the philosophical aspects of biological individuality in Canguilhem, it is necessary to make these clarifications more concrete by analyzing some of the examples that he gives to demonstrate why individuality is a problem for medical judgments. Is it true, as Giroux claims, that his focus on the individual organism is incapable of accounting for those factors that are only visible when one abstracts from the organism and looks at whole populations? Does Canguilhem place too much emphasis on the role of experience and thereby

[68] In what follows, when I refer to 'individuality' in Canguilhem's ideas this means two things. First, it is that which makes one individual unique, and typically refers to human 'individuals'. Second, more generally it refers to *organismic* individuality since, for him, only organisms can be healthy or diseased. As I will discuss, while Canguilhem missed how populations may be individuals, not all populations are organisms. Consequently, the issue about health and disease is not about whether individuals can get sick, but about organisms.

misunderstand the epistemological importance of epidemiological studies and the concept of 'population health'? In the rest of this chapter I will show that it is actually through his injunction to situate organisms in their milieu so as to describe that which concretely determines the organism 'as a whole' that Canguilhem is led to incorporate intergroup, intercultural, and international comparative analyses. Looking at some of these analyses will also help us to address the role of 'experience' in medical concepts and Canguilhem's skepticism regarding the application of 'health' to whole (human) populations. While linking health and disease to geographical, social, or ecological considerations that are admittedly only visible on the population level would seem to bracket individuality and the importance of experience, it is actually there that these issues appear most acute.

2.1. Illustrations of Disease as a Bio-Social Phenomenon

To better frame the examples below, I will first provide Canguilhem's possibly most complete definition of disease that appears in *Writings on Medicine*, a collection of posthumously republished essays. In an essay entitled 'Diseases', he defines diseases as crises that intersect the biological and the social:

> Diseases are crises in the growth towards the adult form and structure of the organs and in the maturation of functions of internal self-conservation and adaptation to external demands. They are also crises in the effort undertaken to live up to a model of selected or imposed activities and, in the best cases, to defend the values of or reasons for living (2012, p. 40f).

This definition establishes disease as what disrupts developmental, physiological, behavioral, or psychological norms. By having such a broad definition, Canguilhem is able to meet the naturalist aim of seeing disease as a 'risk of the living as such' (2012, p. 35), threatening plants and animals as much as humans. By disrupting these bio-social[69] aspects of the living being, disease presents itself, especially with humans, as an 'existential test' that 'provokes an interrogation of the precariousness of organic structures' (2012, p. 41). Disease is a test in the sense that it reveals what the organism is or is not capable of tolerating. In humans, this undermines our feeling of security as our biological organization is shown to be precarious, our

[69] It could be argued that this account is similar to Engel's (1977) 'biopsychosocial' analysis of health and disease. However, as Canguilhem wants to establish some continuity between the human and biological, the 'bio-psycho' aspect seems redundant.

demise inevitable. Canguilhem quotes Freud in saying that disease shows the body's way of 'beginning to grow inorganic' (2012, p. 41). Disease is a trial that tests the organism's ability, relative to a given milieu, to tolerate having its norms constricted through such varied crises.

By providing this bio-social definition of disease, Canguilhem takes into consideration not only the biological, but also the environmental and social aspects that contribute to this test or 'experience' of disease (1989, p. 186). It is because the 'the physical and social environment, diet, mode and conditions of work, the economic situation and education of different classes' etc. (1989, p. 268) all shape organismic norms that the line between anomaly and pathology is best determined relative to 'a milieu of life and a kind of life' (2008, p. 128). That such individuality and variability remain a problem for medical judgments is demonstrated through multiple examples that, contrary to Giroux's critique, actually rely on group or population-level studies. While these studies reveal aspects that are only visible when comparing populations, it is the fact that disease, whatever its causes, remains an experience of living beings and not of populations that will underscore Canguilhem's skepticism towards concepts such as 'public health'.

The first set of examples of the 'interdependence between nature and culture … in determining human organic norms' (1989, p. 269) can be found in Canguilhem's discussion of some international variations in physiological norms. One study discussed is René Porak's observations of Chinese and Europeans in the 1930s. Porak witnessed how differences in physiological norms, such as urinary discharge, are related to national lifestyle norms. He explained these differences in terms of diet, geography and levels of physical activity relative to the two populations. A similar relativity of norms was witnessed when he tried to use cow's milk to treat kidney inflammation in some Chinese individuals and observed subsequent urinary irregularities (Canguilhem 1989, p. 168). While we can question Porak's explanation of this phenomenon as being linked to their cultural view that milk is unsuitable to drink, such culturally shaped physiological differences have since been verified (even intra-culturally within China: cf. Yungfa et al. 1984; Sun et al. 2007), and broadened to explain how the genes associated with lactose absorption became normal as a result of the practice of dairy farming in pastoral societies (Laland, Kendal & Brown 2007)[70].

[70] While this last study does not focus specifically on Chinese and European populations, it still seems to explain Porak's observations since lactose intolerance remains the norm throughout China where, with the exception of some groups, dairy consumption and farming are only more recently becoming the norm (Swallow 2003; Myles et al. 2005).

Secondly, Canguilhem discusses a study that revealed the statistical normality of hypoglycemia in African blacks. When compared to European norms, this 'normality' would be considered pathological: 'the black withstands hypoglycemias which would be considered grave if not mortal in a European' (1989, p. 171). While it could be argued that this physiological normality is what determines these individuals' modes of life, Canguilhem argues that it is actually the ways of life that determine what becomes statistically normal, in the sense that such physiological norms are likely the result of chronic malnourishment, intestinal parasitism and the presence of malaria. A third example is a study by Otto Klineberg who found differences in average blood pressure between Chinese and Americans and even witnessed changes in blood pressure in Americans who had lived in China for some years and adopted their lifestyle (1989, p. 270). All three examples suggest that the 'form and functions of the human body are the expression not only of conditions imposed on life by the environment but also of socially adopted modes of living in the environment' (1989, p. 269). In these examples, species-typicality is not that which determines behavior, but it is behavior, be it of the individual or of a group, that shapes species-typical norms, a process that now goes by the name of 'gene-culture co-evolution' (Laland, Odling-Smee & Myles 2010).

To provide further evidence of the role of the environment in determining the distinction between anomalies and pathologies, Canguilhem discusses a study in which an enzymatic deficiency in African blacks was only diagnosed as such when some Africans were living in the United States and receiving antimalarial drugs, such as quinine (1989, p. 282). It was only in the presence of such drugs that the individuals became rather sick and whose deficiency was discovered. However, in the ecological context of Africa such enzymatic deficiencies actually conferred the benefit of resistance to malaria. What determines whether this variation is an anomaly that improves the chances of surviving malaria or whether it becomes a deficiency that can trigger various problems thus depends on the environment in which the individual resides. More recently, the maintenance of this enzymatic deficiency within the African population has been explained in terms of the continued presence of malaria and the survival advantage of having such deficiencies (Nesse & Williams 1994, p. 99). It is the relation between the individual and the environment that seems to determine the biological value of these genetic 'errors'.

The final example to be discussed is one that best exemplifies Canguilhem's bio-social account of disease. It is found in Hans Selye's famous studies in the early and mid-twentieth

century on how repeated stress, in relation to different cultural and ecological factors, affects the form and functioning of the body, particularly the adrenal cortex (Selye 1976; Canguilhem 1989, pp. 30, 271; 2008, p. 130; 2012, p. 39). What Selye's studies show is that through some kind of stimulus, be it a 'foreign body, purified hormone, traumatism, pain, repeated emotion, imposed fatigue, etc.' (Canguilhem 1989, p. 271), an alarm reaction in the body is triggered which entails the secretion of corticosteroids. This reaction is biologically favorable since it allows a stressor to be identified and produces an appropriate response, e.g. what is now called the 'fight-or-flight response'. Under typical circumstances, the organism's defense systems identify the response and react to it, but if the aggression increases in intensity or continues then these systems can become desensitized and no longer react, resulting in a pathological situation[71]: 'If it is normal, given the role of corticosterone in the organism, that every situation of stress causes a suprarenal reaction, it is conceivable that every prolonged catastrophic comportment could result first in functional disease (e.g., hypertension), and then in a morphological lesion (e.g., a stomach ulcer)' (2008, p. 130). Canguilhem remarks that this explains the (epidemiological) observation that English populations who lived through the continual air raids of World War II saw an increase in cases of gastric ulcer (1989, p. 30). Canguilhem also returns to Selye in the essay on diseases in *Writings on Medicine* so as to provide an example of how one's place within the social hierarchy and the individual's representation of it are two more factors contributing to these stress responses (2012, p. 39). The experience of being devalued within society can produce various stress responses that can lead to or exacerbate the pathological problems just mentioned.

Such an example allows Canguilhem to bring social factors, such as working conditions and class inequality, into his understanding of disease. This has more recently been studied in terms of how health inequalities affect biology (e.g., Brunner 1997, 2007), and what are called the social determinants of disease (Link & Phelan 1995). This should clarify the bio-social definition of disease provided at the beginning of this section, such that we can better see how diseases are part of the lived experiences or activities of concrete organisms taken as a whole, i.e., in relation to their biological, geographical, and even political milieu. This implies that physiological norms are best understood in terms of a complex nexus of ecology and chosen or imposed ways of life: 'perhaps human physiology is always more or less applied physiology,

[71] As will be discussed in chapters 5 and 6, this is recently analyzed in terms of allostasis and allostatic overload (McEwen & Wingfield 2003).

physiology of work, of sport, of leisure, of life at high altitudes, etc., that is, the biological study of man in cultural situations which generate varied aggressions' (Canguilhem 1989, p. 271). Similarly to the example of population-level influences on individual experiences, with Selye we see that population-level factors, e.g. one's situation within a hierarchy, influence the experience of health and disease: stress literally changes the body[72].

In all of these examples, health and pathology are relative to the norms of living beings, thus linking these concepts to the practices and activities characteristic of concrete organisms for whom the experience of disease is a lived reality. Since Canguilhem claims that only organisms can be considered sick and since he rejects the claim that societies can be organisms, he is therefore obliged to retain his organism-centered account of disease. With these examples he seems justified in claiming that, contrary to Giroux's critique (2008, p. 183), ecological, social, and contextual factors, such as social norms or environmental stressors (factors which are only visible by considering the population as a whole) show the relativity of medical norms. Pathogenic agents or situations may be properties of the population, but their meaning is inseparable from the organisms whose norms are tested by them. The individuality of organisms remains a problem since whether such population-level factors are applicable to any given organism is not merely a matter of where an organism is situated relative to what is statistically normal for that population, but depends on the organism's unique physiology, behaviors, and relation to its environment. To describe health and disease in terms of experience is to refer to those variations in how organisms live their lives, variations that are themselves a result of the interdependence of nature and culture.

2.2. Can Health and Disease Be Writ Large?

After having shown how Giroux misrepresents the complexity of Canguilhem's position, it is still an open question as to whether the alternative she proposes is plausible in its own right. Can a population be considered healthy and, if so, does this challenge Canguilhem's 'exclusive' focus on individual (organismic) experience? The critique that Giroux levels at Canguilhem at this point is the following. There are some factors that are crucial for understanding health and disease that are *only* visible at the population level and are irreducible to individual organisms,

[72] More recently, the link between stress and pathology has shown that it is not the sheer level of cortisol in the blood but how it affects inflammation that is crucial (Cohen et al. 2012).

such as group immunity, population density, level of social stability, accessibility to health services, social capital, dietary norms, etc. (Giroux 2008, p. 188). To address such factors, medicine need not only focus on individual organisms but also on the population, with the aim of removing these underlying causes. As these factors are often invisible on and irreducible to the individual (organismic) level, this can be explained be assuming a kind of 'individuality' or unity regarding the population. While the population might not be an individual in the same way as organisms are individuals, the fact that it can be individuated suggests, for Giroux, that 'health' could also apply on that level. While this argument has some obvious limitations, a discussion of it will help to make Canguilhem's claims more precise.

First, how does Giroux arrive at the concept of 'population health'? In a 2011 essay, she argues that the epidemiology of the mid-20th century focused on individual risk factors and thus did not see the population as anything more than a statistical instrument to help understand individuals. Even in this theory, however, the individual was not Canguilhem's 'concrete individual', but was only a statistical 'case' (Giroux 2011, p. 74). Moreover, other areas, such as social epidemiology, population health, or collective health, stress that the population is not a mere aggregate of (human) individuals but is of interest as an 'entity' in itself. It is here that the concept of 'population health' becomes possible. Giroux borrows the following definition of population health coming from Canadian researchers Kindig and Stoddart: 'the *health outcomes* of a group of individuals, including the *distribution of such outcomes* within the group' (2003, p. 381; emphasis added). This definition aims to combine the social and physical environments as health determinants with the health outcomes (i.e. changes in health status following an intervention) for individuals within a group, ultimately providing a definition that can be useful for policy makers. Giroux uses such a definition, as well as the claims regarding the invisibility and irreducibility of population-level factors, to argue that 'health' might be applied to the population as a whole[73].

So as to justify why population-level studies are needed to understand health, Giroux presents the problem of determining that a situation is harmful when it is statistically normal in a given population. For example, if smoking, poor diet, or pollution is widespread, and thus

[73] Interestingly, this idea can also be found in Erich Fromm's reply to Freud regarding the nature of 'social neuroses'. In *Civilization and its Discontents*, Freud suggests that one could see an analogy between individual and social development, thereby allowing for an analysis of the 'pathology of cultural communities' (1961 translation, p. 110). While Freud warns that this is just an analogy, Fromm takes this suggestion seriously in *The Sane Society* where he argues that since there are objective features or needs belonging to humans (e.g. connectedness, spontaneity, lack of coercion), those societies that fail to meet them can be labelled as sick (1955, pp. 12-20). I will return to this idea in chapter 7.

'normal', how is it to be considered harmful to health (Giroux 2011)? Is it both normal and pathological? Moreover, how are we to justify an intervention without such population-level determinations? Only when we examine two populations 'as a whole' can we discern such issues since any individual clinical studies, e.g. Canguilhem's stress on individual experience, will provide little to no useful information.

There seem to be a few problems with this account. First, the problem Giroux presents concerning something that is statistically normal and yet harmful seems precisely what Canguilhem's critique of statistical normality was meant to clarify. As I argued in the previous chapter, fitting individual organisms within statistical averages is insufficient to determine their health or disease. Widespread behaviors or environmental factors would be considered *pathogenic* insofar as they hinder organismic normativity. We know that these factors are present by comparing populations, but without reference to individual *pathologies* it would be difficult to determine the pathogenicity of such factors. Second, is there not an important difference between disease etiology and ontology such that to conflate them would commit a category error of applying to populations what is the property of individual organisms? Of course we cannot completely *know* what constitutes the etiology of something like cardiovascular disease without appealing to population level factors, e.g. national dietary and exercise norms[74] (Giroux 2008, p. 185), but that does not mean that these norms are analogous to the arterial inflammation, increases in plaque, etc., i.e. the actual *effects* of these factors on the individual. To speak of 'population health' as analogous to organismic health, in other words, seems to conflate what Canguilhem calls the 'social genesis of disease', the social or population-level factors/causes, and the disease itself, i.e., the 'role and sense of disease in human experience' (2012, p. 40).

Population density, for example, is a quality of the population and yet what is medically relevant is its *effects* on individuals, what epidemiologist Ana V. Diez Roux calls the 'health effects of group-level factors' (2004, p. 109). Even though a more densely populated society

[74] It should be noted that this has been shown to be rather problematic in the case of dietary saturated fat and cardiovascular disease (cf. Siri-Tarino et al. 2010; Kuipers et al. 2011). Giroux is right to point out the link between diet/lifestyle and disease, but she does not choose the best studies to demonstrate this. For example, the studies by Ancel Keys (producing the 'lipid hypothesis') that sadly continue to be dogma in the obesity debate in the U.S. could serve as interesting examples of what Canguilhem calls 'scientific ideologies', which are 'explanatory systems that stray beyond their own borrowed norms of scientificity' (1988a, p. 38). The resulting hypothesis was spread due to market forces and political interests, not due to the underlying science, making it a good case study in how ideology and the interest to govern the population can outweigh the health of the individual and hinder the dissemination of scientific knowledge (Taubes 2008).

might be less conducive to health and even though this is only known by comparing populations, this does not seem sufficient to undermine Canguilhem's health-salubrity distinction[75]. We can acknowledge the effects of population density on pathogenic incidence in modern towns without making any ontological claims regarding the population and thus without conflating the pathogenic conditions and the pathological experience (Canguilhem 2012, p. 39).

Second, do we even need this ontological claim regarding populations? As I showed above, Canguilhem was clearly aware of the role of group-level factors but was concerned with whether, in an attempt to understand disease, these factors can be understood separately from their effects on individual lives. Such separation can be seen as part of the trend in modern medicine that entails the 'progressive dissociation of disease and the sick person, seeking to characterize the sick person by the disease, rather than identify the disease on the basis of the bundle of symptoms spontaneously presented by the patient' (Canguilhem 2012, p. 35). It is this dissevering of the disease-patient relation that he is concerned with when moving to the level of society. For example, suppose we use her example of herd immunity (Giroux 2011), which suggests that as more individuals in the population are vaccinated this allows for a protection on the population level for those individuals who are not immune. While the *type* of intervention needed requires reference to population-level properties, the fact that infections have posed concrete problems to individuals, or could do so in the future, seems to explain why medicine is interested in them at all and why an intervention is even needed. For Canguilhem, if the disease is separated from its lived pathological effects, then the medical justification for such interventions would be questionable. It seems that interventions can be justified without transposing 'health' to the population.

Third, in the above description of population health, it was mentioned that Kindig and Stoddart's intention was to develop a concept that is useful to policy makers. Herein lies another reason for Canguilhem's critique of such concepts. In various essays and texts, Canguilhem discusses the history of the concept of 'public health' or 'public hygiene' (1988b, p. 23; 2012, pp. 32, 38-39, 48-49), which seems quite similar to 'population health'. From the end of the 18th Century and into the 19th Century, particularly in France and England, the concept

[75] Giroux does mention this distinction (2011), but, based on her claims regarding the invisibility of some effects, the irreducibility of social factors and the existence of population-level properties, she feels that something more is needed. My intention here is to show that her claims remain unconvincing. I will return to this health-salubrity distinction shortly.

of public hygiene was partly linked to the growing interest of industrial society in the 'human component of productive forces' (2012, p. 38). Attempts were made to monitor and ameliorate the living conditions of the working classes, and such attempts were facilitated by the transition from hospices to hospitals where diseases could now be analyzed and classified (2012, p. 38; cf. Foucault 2003b). As medicine and politics converged with the rise of social medicine and epidemiology in the third part of the 19th Century, the concern was no longer the health of the individual, but the security of the population, which seeks the 'negation of disease, the demand to not have to know it' (1988b, p. 23)[76].

Canguilhem's awareness of this history influences his skepticism since it has traditionally been the case that the 'hygienist endeavors to govern a population – individuals are not his business' (2012, p. 49). This concern with regulating the lives of individuals is what contributed to the occlusion of the existential meaning of health by the 'demands of accounting' (2012, p. 48). The problem at hand is that questions of public hygiene are irreducibly political questions since they entail the regulation of people's lives. In itself this is not negative, since, as Nikolas Rose correctly argues, medicine has always been about altering how we relate to our bodies and live our lives, e.g. influencing dietary and sanitary norms (2007a). However, this link between medicine and regulation is also what allows the institution of medicine to focus less on the needs of individuals than the demands of policy makers, such that individuals are not viewed as living beings that suffer, but parts of a social calculus[77] or 'human capital'[78]. As it has been put elsewhere, in modern capitalist societies health has become – to some extent – a matter of productivity (Harvey 2000).

When the medical industry becomes an apparatus of the state, i.e., when medicine becomes social medicine or population medicine, then there is an attempt to regulate the social body according to the statistics arrived at through epidemiological studies (population health as

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[76] All quotes from this 1988b text and the 1985 are my translations.

[77] Cf. Adams' essay 'Against Global Health?' in *Against Health* where he argues that in our current age of 'global health' initiatives, health is approached via the validity of research agendas, rather than the alleviation of suffering, turning health into a matter of accounting and social calculus: 'health is something that can no longer be simply about the absence of illness or disease. Health is now tied invariably to the success or failure of research that advances our knowledge of immunology, genes, and randomized strategies' (2010, p. 54).

[78] In an otherwise rather interesting report on developmental plasticity and human disease, the authors are led to make some conclusions regarding the economic benefits in terms of labour productivity that could be accrued in those societies where knowledge of developmental history informs the health intervention programs: 'Because early growth and development is a time in human life when substantial biological stock is transferred to future generations, ignoring the processes by which this transfer takes place risks erosion of future human capital in both health and economic terms' (Gluckman et al. 2009, p. 1656). The suggestion to use developmental biology to improve human capital seems to be a clear case of 'biopolitics' (Rose 2007b).

social security). The worry that Canguilhem has with such a situation is that at this point we return to the problem of reducing normality and pathology to quantitative variations where pathology is a deviance with respect to the social body (1985, p. 403). Normality no longer has 'the flexibility of a norm which is transformed in its relation to individual conditions', but takes on 'the rigidity of a fact of collective constraint' (1989, p. 182). As such, the individual's experience or ability to discern this distinction in relation to his/her needs and activities is reduced to the individual's relation to the general population, to a health norm imposed on all. It is no longer a question of viewing pathology as a quantitative deviation from the norm considered physiologically, but of a quantitative deviation from the norm considered socially (1985, p. 404).

Furthermore, it is in the practice of medicine that the problem of individuality returns since in the end it is the individual's health or sickness that legitimizes medical intervention, be it on the individual or population level:

> Regardless of the complexity and the artificiality of the technical, scientific, economic, and social mediation of contemporary medicine and regardless of the duration of the suspension of the doctor-patient dialogue, the resolution of the efficacy that legitimizes the medical practice is founded on that modality of life that is the individuality of man (Canguilhem 1988b, p. 29).

Medicine stops being a science and simply becomes an ideology (a 'biological technology' (1988b, p. 23)) without reference to the individual's ability to determine the meaning of health and disease. Consequently, such a view can also easily create stigmas regarding certain behaviors which are then moralized as evils to be removed from the social body[79].

Canguilhem's focus on the individual, then, could be seen as a way to prevent or critique such moralizing judgments and political abuse. This problem could also be addressed if we simply use two different concepts, an option Giroux herself considers. At the end of her main essay critiquing Canguilhem, she suggests that just as it is convenient to distinguish different concepts of causality when referring to populations and individual organisms, it might be necessary to distinguish two distinct concepts of health (2008, p. 193). This seems to be precisely what Canguilhem was doing by distinguishing between 'health' and 'salubrity'[80] (2012, p. 49), the latter concept being preferred over 'public health'. Canguilhem's definition of

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[79] Cf. LeBesco's 'Fat Panic and the New Morality' in *Against Health* (2010).
[80] While he makes this distinction in a few places, he never really develops it in the systematic way that I suggest.

health as the individual organism's ability to adapt implies putting 'the individual patient, not the doctor, in a position of self-determining authority to define his or her health needs' (Horton 2009, p. 781). Salubrity, on the other hand, would not refer to the experience of health, but to *the conditions that are conducive to health*. Through various types of interventions, social institutions might be able to improve the living conditions of individuals and thereby address pathogenic incidence (increasing salubrity), but health cannot be legislated since it 'is not at all an economic exigency to be asserted within a legislative framework; it is a spontaneous unity of the conditions for the exercise of life' (Canguilhem 2012, p. 62). As health is relative to the organism's needs in a given environment, it would make more sense when referring to populations to speak of those conditions that are conducive to these needs, rather than referring to the population as if it, too, were in a position of 'self-determining authority'.

Finally, as I stressed in the previous chapter, Canguilhem sees 'experience' as a biological, rather than a transcendental or phenomenological[81] category. By relating health and disease to experience, from amoebas and plants to humans (1989, p. 198; 2012, p. 35), Canguilhem is referring to those biological and physiological behaviors that arise due to the non-indifference or responsiveness of living beings. Consequently, he argues that when the concept of disease is discussed, the object that this concept refers to is not indifferent to being diagnosed: it is an individual organism that is capable of suffering.

> The sick is a Subject, capable of expression, who recognizes himself as Subject in all that he knows how to designate only by possessives: his pain and the representation that he makes of it, his anguish, his hopes and his dreams. … [I]n the objectivity of medical knowledge it is impossible to annul the subjectivity of the lived experience of the sick (1985, p. 409).

While not all organisms have the same type of 'experience' as the human 'subject' referred to in this passage, being responsive to an environment is crucial for survival at any biological level and insofar as disease disrupts this responsiveness the problem of 'experience' or the testing of norms arises. Experience cannot be dissevered from the concept of disease because disease cannot be dissevered from the organism that undergoes this transformation. It is thus not merely a theoretical problem, but is always a problem for concrete living beings faced with the

[81] 'The consciousness that patients have of their situation is never a wild, bare consciousness. We cannot ignore the presence, in the lived experience of the patient, of the effects of culture and history' (1985, p. 409). Canguilhem's critique of basing the norms of living beings on some pre-reflective realm devoid of knowledge is clearly an allusion to Merleau-Ponty's posthumous text, *The Visible and the Invisible* (1968).

possibility of a disruption that could spell the difference between life and death: of organs leaking or failing, of the body's immune system attacking itself and devouring the body from within, of an uncontrollable deterioration of bodily functions, of abnormal growths disrupting habitual activity, of being confined to a bed with continual pain and suffering despite attempts to mitigate them. In short, of having one's way of life and even sanity threatened or destroyed by these bodily disruptions that we call disease. Stressing 'experience', then, is simply another way for Canguilhem to support the view that health and disease are relative to the individual organism who is the primary 'self-determining authority' when it comes to medical judgments.

In the end, epidemiological analyses can reveal the etiology of these concrete human problems and help with their diagnosis and treatment, but such analyses neither erase the palpably real disease-patient relation nor do they seem to offer anything analogous on the level of populations. What remains to be seen, however, is whether this concept of 'experience' can do any more explanatory work, since it remains rather vague. How does an amoeba's ability to respond in various ways to environmental stimuli compare to that of other animals or plants, let alone to humans? Are there some biological properties that could help to make these claims more precise? Subsequent chapters will explore these questions in more detail.

3. Conclusion

I hope to have shown that two of Giroux's main critiques of Canguilhem, the first regarding his stress on individuality and holism, the second regarding his inattentiveness to population-level dimensions of health, both involve serious misrepresentations of his position. It is because organismic individuality is relational that multiple factors are required so as to understand the organism 'as a whole'. This reading of Canguilhem allows for a better understanding of the many examples that he gives to demonstrate his position and for clarifying why 'experience' is central to his account of health and disease. Nearly all of the aspects Giroux wishes to account for – the etiology of disease, the role of geography, environmental triggers, social norms and behaviors (such as diet and life style) in determining pathogenic incidence, etc. – are all precisely what Canguilhem's examples demonstrate.

Finally, it is not clear that Giroux's concept of 'population health' can escape the problem of conflating the pathogenic and the pathological. Even if it did, she still runs into the political and moralizing problems that emerge when health is transposed to the social level. To

be fair, Giroux does acknowledge Canguilhem's political worries (e.g. Giroux 2008, pp. 182-183), but seems less interested in them and more interested in whether 'population health' is a coherent concept. The continued growth of political battles surrounding modern medicine – e.g. increasing medicalization (Conrad 2007), the horrors of pharmaceutical testing (Barlett & Steele 2011), the positive and negative possibilities of biomedicine (Rose 2001), and the moralization of health, be it with individuals or globally (Metzl & Kirkland 2010) – could provide further instances in which health and salubrity need to be distinguished.

What remains to be addressed, then, is the biological basis of her critique. After suggesting that the individual organism has lost its central place in modern biology, she does not ask whether this loss is warranted and seems to ignore other possibilities for defending an organism-centered approach. I will take up these lacunae in the next chapter where I will show that, as was the case with the above critiques, the problematic nature of her analysis will provide yet another instance to show the pertinence of Canguilhem's supposedly 'untenable' theses.

Chapter Four

The Recalcitrant Organism: Rethinking Biological Normativity

> Since the living experience disappears when the organism is taken apart, many aspects of human life can be understood only by studying man's function with all its complexities and in the responses that he makes to significant stimuli. Such a study would require an organismic and ecologic attitude very different from the analytic one which now prevails in biology.
>
> René Dubos, *So Human An Animal*

In the last chapter I showed that the critiques Giroux levels at Canguilhem are far from univocal. While the status of 'population health' remains open for debate, one of the premises that allows Giroux to support the usage of this concept is her stress on how the individual organism has been displaced in modern evolutionary theory. In other words, she claims that while for Darwin the individual organism was the primary 'unit of selection', there now seems to be strong evidence to think that selection can occur on levels above and below the organism, such as genes and populations (Giroux 2008).

As with her other critiques, this one, too, is problematic. While it is certainly true that 20th century biology appealed to multiple levels to help explain natural selection, what it has not done, at least not nearly as definitively as Giroux suggests, is to completely displace the organism. In fact, it seems possible to argue that in many aspects of biological theory, from developmental biology and niche construction to epigenetics and others, the role of the organism 'as a whole' is actually gaining in significance (Bateson 2005; Nicholson forthcoming). In this chapter, I will first ask whether the levels of selection debate is even relevant for medicine in the way Giroux assumes it is. Second, I will briefly explore some of these newer areas of research that challenge the supposed eclipsing of the organism in evolutionary theory. Third, I will look at two more sophisticated accounts of the 'organism' that Canguilhem's position has much in common with, and which support a 're-centering' of the organism. Finally, I will analyze some examples of what Canguilhem described as 'biological normativity' and show that this concept was meant to account for both individual and species norms. I will clarify what Canguilhem meant by this concept by comparing it to some more recent discussions in biology concerning plasticity as a property of organisms and evolvability as a

property of species or populations. Together these points will further undermine Giroux's critiques of Canguilhem and, more importantly, show how he remains relevant to contemporary philosophy of biology.

1. Is the Levels of Selection Debate Relevant to Medicine?

In Giroux's critique of Canguilhem, she claims that he overemphasizes the role of the individual organism for understanding evolutionary processes. If natural selection can be understood as operating on levels other than the organism, then Canguilhem's supposed appeal to evolution to support his organismic account of health is troubled. While one could initially object by saying that it is unclear whether Canguilhem upheld the empirical claim that natural selection only acts on organisms, it will still be instructive to explore what is at stake in this debate.

The main idea in the debate concerning units of selection[82] has been to clarify what is selected by natural selection. While traditional Darwinism typically focuses on the individual organism's survival and reproduction as what drives evolution, this was challenged throughout the 20th century. During the 1960s and 70s, for example, some argued that the true unit of selection was not the individual organism, but the genes, since after all genes are what are transmitted to the next generation, they are the 'replicators' (e.g. Williams, Dawkins). In reaction to this, there were many biologists in the 1980s who argued that such 'gene-centrism' fails to account for phenomena such as altruism in which selection seems to occur on levels higher than the gene and organism, such as the group (e.g. Wilson, Sober, Lewontin, etc.). As might be expected, there were many who argued for a more pluralistic approach, such that natural selection operates on different levels of this hierarchy simultaneously (e.g. Gould, Maynard Smith, Michod, etc.). Ultimately, the general consensus seems to be that natural selection can occur on different levels (i.e. there are various beneficiaries). However, it remains hotly debated how important selection at higher levels (e.g. groups, species) is (Okasha 2006b). While this debate has become more complex and continues to this day, what is of interest to

[82] I will be using the phrases 'levels of selection' and 'units of selection' more or less interchangeably in this chapter. There are a series of related concepts and issues that I will not be able to fully address in this debate, which pertain to what it is that is replicated in each generation, e.g. genes, developmental processes, etc. (replicators), whether organisms are merely vehicles, what is causally interacting in an environment (interactors), what interactions are relevant for changes in gene frequency, and who/what it is that benefits from these changes (the beneficiaries) (cf. Okasha 2006a). In what follows I will try to specify which of these issues is at stake (replicators, vehicles, interactors, and beneficiaries) while remaining largely agnostic regarding their utility or validity.

Giroux is that the individual organism seems to have been displaced from the center of evolutionary theory.

Before going into some further complexities of this debate, I would like to take a different approach and begin by asking what relevance this debate has for the philosophy of medicine. Philosophers on both sides of the naturalism-normativism divide have used the issue of units of selection to problematize or clarify the role of evolution (e.g. Engelhardt 1978; Boorse 1997). The main reason for this seems to be that if some trait is beneficial for the transmission of genes or for group survival, but in either case is harmful for the individual organism, then this seems to make it difficult to discern whether the trait is normal or pathological. As Nesse asks: 'at which level of selection should we define abnormality' (2001, p. 43)? If natural selection acts on (or benefits) genes or groups, then maybe the concepts of health and disease need to be reworked so as to account for such occurrences.

If we look at some examples, we can see how these claims could be substantiated. On the level of genes, it has been suggested that health judgments should consider the phenomenon of pleiotropy, i.e. the various phenotypic effects of a given gene. Nesse (2001, p. 43) provides the hypothetical example of a gene that codes for improved sperm motility but which causes some serious disease later in life. As it is initially advantageous, this gene would likely be selected for despite its later deleterious effects. A non-hypothetical example of pleiotropy would be that of stem cells which are initially adaptive by aiding tissue maintenance and repair, but which increase the risk of neoplasia later in life (Gluckman, Beedle & Hanson 2009, p. 263). For an individual organism, these traits would be pathological, yet from an evolutionary perspective they seem healthy. Moving to a higher level, it has been argued that gestational diabetes might have some adaptive benefits for the fetus, even though it harms the mother, and thus traits allowing for this diabetes could be favored (Haig 1993). Whereas it seems pathological for the mother as an individual, an evolutionary perspective could suggest that it is a 'healthy condition' (Ananth 2008, p. 211), possibly because, like morning sickness in general, it has adaptive benefits for both the mother and her embryos (Sherman & Flaxman 2002).

While these examples raise some interesting questions, I want to suggest that the relevance of this debate has been overstated. First, it has been pointed out by many researchers working within the new field of 'Darwinian Medicine' that we should expect there to be a discrepancy between what is selected for in a given population and the resulting effects on individual health precisely because natural selection shapes organisms for the maximization of

reproductive success rather than health (Nesse & Williams 1994; Gluckman, Beedle & Hanson 2009). Processes at the genetic or group level can give rise to various forms of adaptations that need not result in the health of the organism but merely ensure that its capacities for survival and reproduction are sufficient to allow for the maintenance of this adaptation. Consequently, if natural selection does not promote health, then it is not clear why Giroux would focus on this debate to question Canguilhem's approach. Second, without clarifying the different concerns of biology and medicine, it seems possible to conflate descriptions of natural variation with their medically relevant effects in a given individual[83]. In other words, while the pleiotropic effects of genes are 'normal and natural', it is a different question as to whether they constitute a disease in the organism 'as a whole' (Gammelgaard 2000, p. 114). Rather than asking whether a condition such as gestational diabetes is a disease, it seems more helpful to ask under what conditions it could become pathological[84]. Even if mild or 'normal' levels of it are adaptive, the mother's potential suffering cannot be so easily bypassed. Third, such issues have led some to argue that basing medical judgments on evolutionary considerations is problematic since in the end physiological explanations and medical experience are the most useful (Cournoyea 2013). Whether or not something is beneficial for genes or groups remains secondary to whether it affects a given organism's ability to function in its environment. Thus, if natural selection is not concerned with the health of individual organisms, if there is an important difference between biological and medical goals[85], and if physiology coupled with medical experience ultimately guides medical judgments, then it is not clear why multi-level selection would challenge a focus on organisms when it comes to conceptualizing health and disease[86]. As I showed in the previous chapter, even if there are multiple causal forces involved in disease etiology, this need not be conflated with disease ontology.

Despite these reservations, if we decide to take Giroux seriously that the levels of selection debate implies a rethinking of health and disease, then it is reasonable to ask whether her presentation of the debate is accurate. While accepting the possibility of multiple levels of

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[83] 'The idea that some variation is "normal" and some "abnormal" has no place in evolutionary theory' (Stearns et al. 2008).

[84] It is interesting to point out that while exploring the potentially adaptive benefits of various traits, e.g. morning sickness, it is still only 'normal' levels of them which are adaptive (Sherman & Flaxman 2002).

[85] Gammelgaard concludes that in medicine 'all goal-states are determined in relation to the individual, while in evolutionary biology, goal-states are determined to the unit of selection and the unit of selection need not be the individual' (2000, p. 115). Consequently, one cannot deduce a concept of disease from evolutionary theory.

[86] This issue of how evolutionary considerations contribute to our understanding of health and disease is more complex than being argued here. I will return to it in detail in the next chapter.

selection, is there a reason to uphold the individual organism as at least the primary unit[87] and is the 'organism' still a useful explanatory concept in biology?

2. The Centrality of the Organism

There is a sense in which Giroux's depiction of the decentering of the organism from evolutionary theory is understandable. As I have already mentioned, throughout the 20th century there was a shift to studying entities and processes well below and well above the level of the individual organism, largely fueled by the growing importance of population genetics. The transition to thinking about evolution in terms of populations largely came about through the rise of what is known as the Modern Synthesis, whereby Darwinian evolution was tied to Mendelian principles of heredity and genetics. As this synthesis focused on the forces affecting gene frequency in populations, the relevant forces were those that favored genes or acted on levels different from the organismic level. While the organism was still a possible level of selection, explanations of the main processes of evolution could thereby be carried out while bracketing the traditional 'organism as a whole' (Huneman 2010). Concomitantly with the Modern Synthesis there was the rise in molecular biology that allowed for new ways of studying living beings, focusing particularly on the structural properties of macromolecules. Together, these two areas of biology contributed to placing more emphasis on the role of genes for understanding evolutionary dynamics (so-called 'gene-centrism'), and resulted in seeing the 'organism' as epiphenomenal and possibly even non-existent (Sterelny & Griffiths 1999). As such, the organism was not needed to explain evolution (Nicholson forthcoming).

While this situation does support Giroux's claims, what she fails to point out is that these views were never universally shared by biologists throughout the 20th century (e.g. Waddington, Haldane, Bertalanffy, Mayr[88], Lewontin and Gould all challenged the above interpretation in one way or another). As with any general trend in science, there were a variety of dissenting opinions even from the start. Moreover, it is this very displacement of the organism that has been more recently undergoing critique. While evolution was traditionally used to explain why there are organisms, it is becoming more common to base explanations of

[87] For example, Giroux references Lewontin who is an advocate of multi-level selection, but misses his quote that the individual is still the primary unit (1970, p. 7).

[88] Huneman (2010) points out that one of the main 'authors' of this new synthesis, Ernst Mayr, was critical of this stress on gene frequency to understand evolution. Evolution, for Mayr, is a matter of maintaining adaptedness which in turn results in changes in gene frequency.

evolutionary processes on organismic properties, such that the 'organism as a whole' now seems to play a fundamental role in explaining evolution (Nicholson forthcoming).

Despite developmental biology being a richly studied area throughout the 20th century, the explanatory role that it played in the Modern Synthesis was diminished as its effects on inheritance or adaptation were unclear. It seems possible that a recentering of the organism is coming about as development and embryology are placed within the center of evolutionary theory (Gilbert & Epel 2009). For example, philosopher of biology Philippe Huneman (2010) claims that this shift is supported by various empirical findings in developmental biology where development is understood as a complex process wherein genes are regulated through other genes and intracellular entities, which in turn influences cellular tissues, with cellular-level properties in turn influencing gene regulation. This whole process is then shaped and further regulated by the organism as a whole as it develops in its environment. In this view, organisms are self-organizing entities in which their parts develop in relation to an 'idea of the whole organism … Without assuming such an idea of the whole we could not distinguish between pathological and normal developments' (Huneman 2010, p. 358). It should be rather evident that such a view, largely inspired by Kantian ideas concerning organismic self-causality, shares much in common with the views of Goldstein and Canguilhem discussed in the previous chapter.

This emphasis on the whole organism can be found in various areas of biology. One of its roots can be found in Gould and Lewontin's critique of claiming that any given trait should be considered an adaptation as this often leads to 'an evolutionary biology of parts and genes, but not of organisms' (1979, p. 597)[89]. For Gould, most body parts are the result of hundreds of genes and

> their action is channeled through a kaleidoscopic series of environmental influences: embryonic and postnatal, internal and external. Parts are not translated genes, selection doesn't even work directly on parts. It accepts or rejects entire organisms because suites of parts interacting in complex ways, confer advantages (1980, p. 91)[90].

More recent philosophers of biology have taken up this critique of 'atomism' or reductionism, arguing that natural selection only 'sees the organism' (Dupré 2005, p. 39). As biologist Patrick

[89] Here the concern of Gould and Lewontin is not that of replicators or beneficiaries, but of interactors (i.e. the units that are causally interacting with the environment).
[90] This quote can also be found in Ananth (2008, p. 213) who provides some critiques of gene and group selection, concluding that it is still reasonable to consider the organism as the primary unit.

Bateson writes: 'Whole organisms survive and reproduce differentially and the winners drag their genotypes with them. This is the engine of Darwinian evolution and the reason why it is so important to understand how whole organisms behave and develop' (2005, p. 37). It has even been argued that the fact that the organism is itself a unit of selection (i.e. being an interactor) is a contingent result of feedback dynamics in evolution. As natural selection tends towards functional integration those entities that are functionally integrated with their environments, such as whole organisms, will be favored (Ruiz-Mirazo et al. 2000; Pepper & Herron 2008). Such examples suggest that the methodological injunction to understand the whole organism is becoming more common in contemporary biology (Nicholson 2013).

It could be argued that such examples are merely suggestive and by no means suffice to constitute the centrality of the organism. Two areas of contemporary biology can help to make these suggestions more concrete. First, one area within contemporary biology that also deals with development and tries to situate its significance within evolution more broadly is the area of developmental plasticity (Pigliucci 2001; West-Eberhard 2003). With the aim of addressing the undervalued role of development in the Modern Synthesis, as well as the overemphasis placed on genetic mutation as the main source of selectable variation, this area emphasizes the plastic relation between genes and phenotypes, the latter being those visible traits that often occur on the level of the organism. More specifically, it aims to show how there is responsiveness or 'non-indifference' inherent to the process of development such that, through various environmental triggers (e.g. variations in temperature, pathogens, or parental influences), novel phenotypes can occur prior to genetic mutations (West-Eberhard 2005a). Such phenotypes, if adaptive, can then put new selective pressures on the genes that are associated with those aspects of development that would allow these phenotypes to become 'accommodated' or 'canalized' (Waddington 1942). In other words, if adaptive, these new traits will be favored by natural selection and thereby become normalized within a population.

As biologist Mary Jane West-Eberhard argues, while there are exceptions most 'genes under selection depend for their differential propagation on the differential reproduction of the bodies that contain them. That is, *genes can replicate themselves, but only within organisms*[91]. To spread within populations, they depend on their ability to affect the reproduction of their bearers; they depend on their effects on phenotypes' (2005a, p. 6543; emphasis added). While

[91] With this comment, West-Eberhard is referring to the vehicle issue, i.e. organisms are vehicles for genes, but with the suggestion that the vehicle (the organism) has properties (plasticity) that drive changes in gene frequency.

this may not constitute a full-blown return of the whole organism, it stresses the fact that an 'organism's phenotypes have the lead in evolutionary dynamics' (Huneman 2010, p. 347), or are at least a primary agent. In this view, the organism's relation to its environment, the various forces acting on development, and the organism's own behaviors all influence whether and how changes in gene frequency will occur. It is this stress on the phenotype – the observable structures and behaviors of organisms – that would constitute a renewed interest in what happens on the level of the organism as a whole. I will return to the idea of plasticity in Canguilhem below.

A second area of contemporary biology that has contributed to the return of the organism is niche construction. This area emphasizes the evolutionary implications of organisms actively carving out their milieu and thereby shaping selection pressures. Richard Lewontin, for example, criticized some traditional views of Darwinism that tended to separate organism and environment. Instead, he argued that 'at every moment gene, environment, chance, and the organism as a whole are all participating' such that 'the environment and the organism actively codetermine each other' (from Levins & Lewontin 1985, p. 89). As all levels of biological organization dialectically shape an organism's life history, organisms do not simply adapt to pre-existing niches, but actively determine what is relevant in relation to their biological needs. For Lewontin, understanding evolution and adaptation requires a focus on the organism's active behavior in a given milieu since it is this relationship that partly determines the conditions for a trait's selection.

This critique of what has been called 'externalism' (Sterelny 2005), or the environment shaping the traits of passive organisms, has recently been used to explain many 'neglected' aspects of evolutionary theory. According to its main proponents, niche construction is, following natural selection, 'a second major participant of evolution' (Odling-Smee et al. 2003, p. 2). Niche construction can be seen in the many ways in which organisms engineer their own ecosystems, how they modify their own selective environment as well as those of other organisms, how these environmental modifications are inherited, and ultimately how adaptation and natural selection depend on the nature of these constructions. Niche construction can be seen in the actions and behaviors of all living beings: 'Organisms choose habitats and resources, construct aspects of their environments such as nests, holes, burrows, webs, pupal cases, and a chemical milieu, and frequently choose, protect, and provision nursery environments for their offspring' (2003, p. 1). As a result, niche construction aims to explain

how genes can interact with one another through these changes in the external environment brought about by organismic behaviors, how organisms co-evolve through various ecological mechanisms, as well as the evolutionary implications of human behavior and culture:

> From the niche-construction perspective, evolution is based on cycles of causation and feedback; organisms drive environmental change and *organism-modified environments subsequently select organisms*.… Niche construction is not just an end product of evolution, but a cause of evolutionary change (Laland & Brown 2006, p. 96; emphasis added).

This theory provides many examples of how the norms of living beings shape their physiology, from genes to phenotypes, through complex feedback loops, such as the practice of dairy farming creating the conditions for the genes of lactose absorption to increase. As niche construction results from organismic behaviors, the organism's interaction with its environment is placed firmly in the center of evolutionary theory.

While not definitive, what these examples suggest is that there is much empirical work being done regarding the role of organisms in evolutionary theory. Consequently, the units of selection debate is far more complex than Giroux suggests by merely pointing to genetic or population-level selection. Similarly to the issues raised regarding epidemiological analyses, it may be the case that we can only understand certain biological properties through multi-level analyses. That does not mean, however, that this erases their significance for individual organisms or that this somehow renders the organismic level uninteresting or unhelpful for thinking about natural selection. As Gould and Lewontin argue, rather than undermining a stress on the organism, a 'pluralistic view could put organisms, with all their recalcitrant, yet intelligible complexity, back into evolutionary theory' (1979, p. 597). Each of the theories mentioned here attests to the importance of the organism for understanding the processes of adaptation and natural selection and as they continually gain support within the biological community, the organism seems more crucial than ever. Developmental biology stresses the role of the 'organism as a whole' in understanding the nature of developmental processes. Research into developmental plasticity focuses on how the malleability of developmental processes can allow organism-level phenotypes to be the drivers of evolution. Finally, niche construction stresses how the organism's actions and the resulting heritable ecological modifications create feedback loops which shape the conditions of natural selection. None of these theories would be fully comprehensible without the concept of the organism. In the end, while it is possible to argue that the organism was displaced within the units of selection

debate, it is still relevant to many other aspects of evolutionary biology and may very well become more relevant in the years to come.

3. Redefining the Organism

Another possible objection could be that while there are organism-level properties that seem to be units in natural selection, it is still not clear what an organism is (or whether it exists: Ruse 1989) and this lack of clarity could also undermine the view that health and disease are only properties of whole organisms. If the organism is better defined, it might further support the claim that the organism is a primary unit of selection. Where can we look for such a definition and is Canguilhem's 'outdated' biology (Debru 1998) still relevant to it?

In a recent essay, philosopher of biology Thomas Pradeu has argued that there is a way to define an organism such that it is not understood as merely one type of biological individual within the hierarchy of individuals, but is actually 'the most clearly individuated of all biological individuals' (2010, p. 248). In other words, this definition gets around the tendency to define individuals simply in terms of what natural selection acts on and shows that organisms are better individuated than genes or groups. The general theory that Pradeu finds more promising than that of evolution by natural selection comes from physiology, according to which organisms are individuals because they are functionally integrated wholes (2010, p. 252). However, what physiology on its own fails to specify are the criteria for why organisms, rather than merely any functional unit, should be considered individuals. To provide that criteria, Pradeu uses ideas from immunology where it is argued that as immune systems define what will be accepted or rejected as part of the organism, they constitute the organism as a functional unit (2010, p. 253). Moreover, it is now believed that immunity is not simply a property of higher vertebrates, but is ubiquitous throughout living beings, making it a good candidate to individuate organisms[92]. Immunology suggests that functional integration can be best seen on the biochemical level (particularly in protein-protein interactions) and that immune interactions 'are fundamentally *organismic* (i.e. they concern the whole organism), because they are *systemic* (2010, p. 258). This allows Pradeu to address the issue of how some

[92] As I mentioned in the first chapter, Canguilhem uses the example of immunity and anaphylaxis to clarify what he means by propulsive and repulsive biological norms. While he certainly was not making the argument that all organisms have immune systems, the fact that he used an example from immunology to illustrate universal properties of living beings brings him rather close to Pradeu's concerns.

organisms are heterogeneous, e.g. humans living with bacteria, or colonial, e.g. the star ascidian, but are still individuals since they are functionally integrated through immune reactions (2010, pp. 259-261). Such organisms appear to be heterogeneous 'unified wholes' with their parts dialectically related on the level of immunity. All of this leads him to define an organism as 'a functionally integrated whole, made up of heterogeneous constituents that are locally interconnected by strong biochemical interactions and controlled by systemic immune interactions that repeat constantly at the same medium intensity' (2010, p. 258). With this definition it is possible to specify what is meant by the vague expression of the 'organism as a whole', providing yet another argument for not only why but how the organism is central to biological theories.

In a recent lecture describing many of the new advances in contemporary biology and their philosophical and scientific implications, philosopher John Dupré (2007) argues that while the pluralistic approach to selection is still reasonable, one can also see the organism as the primary unit of selection if more recent findings are considered. First, he also argues that organisms are better understood as heterogeneous functional wholes. For example, many animals, from arthropods and plants to mammals are covered with or have a necessary symbiotic relationship to indigenous bacteria. In humans, the bacteria and microbes that cover every surface of our body and appear to constitute roughly 99% of the genes on our external surface play a role in digestion, development, reproduction, in training our immune system, and helping the nervous system (2007, p. 36). Moreover, colonial organisms such as the Portuguese man o' war also illustrate this functionally integrated 'communal' aspect (whose individuation can be clarified in terms of Pradeu's immunological account). Second, as we saw with niche construction, organisms are no longer viewed as passive recipients of their environment due to the complex feedback loop between organismic physiology and their constructed environment. Human constructions such as schools, hospitals, buildings and even farming practices are all clear examples of niche construction. Third, building on the insights of developmental biology, the organism is not a static entity with fixed properties, but a dynamic process involving interacting cycles (Dupré 2007, p. 54). Together, these criteria allow Dupré to describe the organism as:

> a process – a life cycle – rather than a thing; it may be a community of distinct kinds of organisms rather than a monogenomic individual; and it must be understood as conceptually and of course causally linked to its particular environment, or niche, which

> both contributes to the construction of the organism in development, and is constructed by the organism through its behavior (2007, p. 54).

If these qualifications are taken into account, Dupré claims, then some issues within the units of selection debate may need to be reconsidered. While this would have to be determined empirically, it at least suggests that the organism may be the primary unit of selection. It seems likely that coupling these aspects with Pradeu's account would further strengthen this argument.

With these two rather recent approaches to redefining the organism, I want to now mention a few key aspects of Canguilhem's position so as to counter the claim that his biology is outdated. In an essay on the relation between parts and wholes in biology written in the 1960s, Canguilhem argues that while viewing organisms as 'societies' is a problematic metaphor imported from political theories, one idea that has persisted since the 19th century is that the organization of parts in organisms entails a kind of regulation whereby competition is converted into a form of compatibility (1994, p. 302). As such, the organism is a 'regulative totality controlling developments and functions' (1994, p. 302). As I specified in the previous chapter, the concept of organism, for Canguilhem, implies 'organic regulation' or the systemic control 'by a totality over its parts (2012, p. 73), as is shown in physiology. While this remains somewhat imprecise, his 'holism' lends itself perfectly to viewing the organism as a genomically diverse community, or heterogeneous individual, which acts as a functional whole because regulated by organismic (immunological) properties. This also has implications for the previous chapter's discussion regarding populations and individuals. The theories mentioned by Dupré and Pradeu imply that organisms are composites, but it is their functional integration, e.g. by means of biochemical and immune reactions, that seems to support Canguilhem's criticisms of seeing *human* societies as organisms. As such, Giroux's extension of health to 'populations' would seem justified for those populations that are also organisms, but not for any population. It is one thing to see human populations as individuals, but another to see them as organisms, and only for the latter do the concepts of health and disease seem to apply.

The second qualification mentioned by Dupré concerning the organism's active involvement in shaping the dynamics of evolution is possibly the clearest place where the issues of interest to Canguilhem are still with us. Similar to the examples mentioned above in relation to niche construction, Canguilhem, too, stresses the significance of the activity of living beings. For example, he argues that while medicine was not a necessary consequence of biological or

human evolution, its emergence as a cultural practice is better understood as part of the active way in which living beings respond to and shape their environment (1989, p. 130). It is this emphasis on biological non-indifference that allows Canguilhem to develop a position that is nearly identical to that of niche construction[93]:

> if the organism-environment relation is considered as the effect of a really biological activity, as the search for a situation in which the living being receives, instead of submits to, influences and qualities which meet its demands, then the environments in which the living beings find themselves are carved out by them, centered on them. In this sense the organism is not thrown into an environment to which he must submit, but it structures its environment at the same time as it develops its capacities as an organism (1989, p. 283f).

While many other examples could be given, this should suffice to demonstrate that Dupré's second qualification is clearly presaged in Canguilhem's writings.

Contained within these ideas, we can also find the means to account for the third qualification that the organism is not a static entity, but a dynamic process. While organisms are functionally integrated wholes dynamically interacting with their environments, they are constantly undergoing changes on various levels – from metabolism to morphology – in relation to changing internal and external demands (Canguilhem 2012, p. 72). The idea that organisms are temporally defined by their changing habits, by their polarized relation with their milieu, fits within Canguilhem's view of life as an 'organization of forces and a hierarchy of functions whose stability is necessarily precarious, for it is the solution to a problem of equilibrium, compensation, and compromise between different and competing powers' (2008, p. 125). Similarly, Dupré argues that life is no longer understood as a hierarchy of static things, but a 'hierarchy of dynamic and constantly changing processes' (2007, p. 35).

Thus, it would seem that on all accounts Canguilhem's position is in alignment with Dupré's three qualifications regarding a rethinking of the organism, and could easily be made more precise by using Pradeu's physiological/immunological definition. Whatever the future outcome concerning whether these definitions will adequately account for what is observed in nature, what is clear is that what could be called Canguilhem's 'feeling for the organism'[94] is far

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[93] Morange (2008b, p. 161) also mentions Canguilhem's similarity to niche construction, but goes on to lament the proximity of Canguilhem's ideas with Lamarckism. For a recent 'defence' of Lamarckian ideas see Jablonka and Lamb (2004).

[94] This phrase comes from the title of Evelyn Fox Keller's 1983 biography of Barbara McClintock.

from outdated and far from being eclipsed by recent advances in biology. As more research seems to further support these theories regarding the nature of organisms, it might very well be the case that it is now more possible than ever to defend an organism-centered biology.

4. Biological Normativity: Plastic Organisms, Evolvable Species

So far in this chapter I have shown that, on the one hand, it is not completely clear that we need to refer to the levels of selection debate in order to establish a biologically coherent account of health and disease, and that, on the other hand, even if we accept that this debate is relevant, it is far from true that an organism-centered view of evolution is inaccurate, especially if we use a more updated definition of organism. There is one final aspect of Giroux's presentation and critique of Canguilhem that needs to be addressed. Giroux claims that due to Canguilhem's individual- or organism-centered approach, there is an 'identity' between normativity and individuality (Giroux 2008, p. 176). If this is true, then he seems incapable of accounting for biological properties at levels higher than the organism, e.g. species properties. While this was partly addressed in the previous chapter, I want to show how it represents another instance in which she misrepresents his account and its implications. In fact, Canguilhem's concept of biological normativity pertains both to organisms and to species, and actually comes quite close to the more recent biological concepts of phenotypic plasticity and evolvability. If normativity is understood by Canguilhem as a biological capacity not only of organisms, but also of species, then Giroux's critique fails.

First, how does Canguilhem argue for biological normativity and how does it relate to phenotypic plasticity? In the broadest sense, Canguilhem defines biological normativity as the ability to establish norms (1989, p. 127) and sees this as a fundamental biological property when he writes that there is 'no biological indifference, and consequently we can speak of biological normativity' (1989, p. 129). What he refers to here as biological non-indifference is a kind of responsiveness to internal and external conditions that allows living beings to establish norms (physiological or behavioral regularities) in changing circumstances, be they healthy or pathological norms. Moreover, Canguilhem understands normativity as what contributes to the 'viability'[95] of organisms. A living being is 'normal', or normative, when it can 'maintain itself in

[95] In a later text he (broadly) defines as viable 'any life form capable of entering into a relationship with an environment for some period of time' (1988a, p. 120).

forms and within norms that allow for a margin of variation, a latitude of deviation, such that as environmental conditions vary, one of those forms may prove to be more advantageous, hence more *viable*' (1994, p. 354). In this sense, normativity can be understood as a potentially adaptive capacity of living beings insofar as it allows norms to be established and thereby become objects for natural selection. However, as the capacity to respond to changing environmental conditions opens the organism to the threat of disease, this would suggest that biological non-indifference can also have its costs. It is this that constitutes the 'dynamic polarity' of life. Going further, the following quote suggests that this non-indifference need not be equated with higher-level behaviors, but can already be seen on the genetic level:

> Without being able to decide whether there exist mutation genes, whose presence would multiply other genes' latitude for mutation (as some have thought can be identified in certain plants), we must note that *different genotypes – the lineages of a given species – present different "values" in relation to ambient circumstances* (2008, p. 126f; emphasis added).

This suggests that biological non-indifference can also manifest itself in terms of how a given genotype can produce various 'values', i.e. phenotypes, depending on the environment in which it occurs ('environment' understood both as the organism's internal milieu and the external milieu). Genes exhibit their plasticity through their responsiveness, their non-indifference, to environmental cues[96].

While he clearly acknowledges the genetic level, Canguilhem's usual usage of the term 'plasticity' refers to how physiological characteristics are related to an organism's activity or behavior in its environment, something that is quite evident in humans (1989, pp. 162, 174). For example, the human ability to alter the environment through the use of tools and technology is an illustration of how 'organic vitality flourishes in man in the form of technical plasticity and the desire to dominate the environment' (1989, p. 201). One can also see a direct analogue of plasticity in Canguilhem's discussion of the work of the geographer Maximilien Sorre who observed a kind of 'instability' (*labilité*) of physiological norms in relation to environmental factors such as pathogens, diet, kinds of activity or work, and even in the relation between the human psyche and development (1989, pp. 169-171; see also Le Blanc

[96] It can also be argued that his views on biological normativity were influenced by the theory of 'mutationism' (Canguilhem 1989, pp. 143, 263), i.e. mutations produce phenotypic and developmental alterations that are then open to selection. This was made popular by the late-19th century botanist Hugo de Vries and also advocated by Richard Goldschmidt, William Bateson and others in the 20th century. While this theory might seem a bit dated, there have been recent attempts to revive it (e.g. Stoltzfus 2006; Nei 2007).

1998). What is normal, especially for humans, is to be able to adapt to changing circumstances through behaviors which in turn shape our very physiology. This idea resurfaces in his later work when he distinguishes between the body as given and the body as product (2012, p. 48). The body as given refers to its genetic aspects, whose normality or pathology depends on the milieu. The body as product refers to how an organism's selected or imposed activities within its milieu contribute to 'fashioning its phenotype' and 'modifying its morphological structure' (2012, p. 48), which thereby individualize that organism's capacities.

While it is unclear to what degree Canguilhem was familiar with the concept of plasticity as it is now defined[97], his views converge quite well with recent research in this area. An initial conceptual difficulty, however, is that 'plasticity' has become a rather broad catch-all concept, not always adequately distinguishing the historically distinct embryological and genetic approaches (Nicoglou 2011) or acknowledging the various influences shaping the history of plasticity research (Sarkar 1999). That being said, one main idea captured by the term plasticity, which has taken various forms in embryological research since at least the 17th century, is that developing organisms react to environmental changes by producing various physiological or behavioral results. In the early and mid 20th century, a genetic approach influenced by the work of Johannsen (1911), Waddington (1942), and Bradshaw (1965), focused on how genotypes react to environmental changes in terms of reaction norms[98], which are the function of the relationship between genotypes and phenotypes (Pigliucci 2001). This genetic approach has become the dominant one such that now plasticity has become 'phenotypic plasticity' and is typically defined as a property of the organism's genotype to react to changes in the environment by producing different phenotypes in terms of 'form, state, movement, or

[97] In an essay on the role of analogies and models in biology, he argues that one of the problems with using mechanical models to describe organisms is that there is a qualitative difference regarding how organisms and machines react to failures of functions. While such failures do not result in a change in the machine's overall behavior in the sense that it adapts to the failure, a failure in an organism, such a lesion, can produce a regeneration or alteration, showing that the lesion 'does not necessarily abolish its plasticity' (1963, p. 516). In *Knowledge of Life* he discusses research in embryology, in particular Hans Driesch's work on pluripotent cells. Driesch showed that development is shaped by constraints as well as being characterized by potentiality or a capacity to develop normally despite being experimentally modified (2008, pp. 90-91). This suggests Canguilhem's familiarity with the idea, if not the concept, of plasticity, as Driesch's work was at the beginnings of our current understanding of developmental plasticity (Nicoglou 2011). In Canguilhem's archived notes from 1942-43 entitled 'Les mathématiques en biologie' (n.d.a), he explicitly references the botanist Wilhelm Johannsen's work (p. 31). Johannsen (1911) is usually credited with the genotype-phenotype distinction, and having shown that a simple one-to-one correspondence between the two was too simplistic due to gene-gene interactions and gene-environment interactions (Pigliucci 2001). Such ideas were very influential for the subsequent conceptualization of phenotypic plasticity.

[98] A reaction norm describes how plastic or malleable a genotype will be across different environments, such that some traits might exhibit a flat reaction norm (non-plastic), whereas others might be highly sensitive to changes (very plastic).

rate of activity' (Gilbert & Epel 2009, p. 7; West-Eberhard 2003). Yet another approach which appeals more to how genetics interact with cellular and morphological processes views plasticity simply as 'stochastic or condition-dependent variability' (Newman et al. 2009, p. 553; Newman & Müller 2000).

For now, I will only refer to the genetic/developmental approach, by which plasticity is defined as 'a property of individual genotypes to produce different phenotypes when exposed to different environmental conditions' (Pigliucci et al. 2006, p. 2363). The main idea is that there is a 'responsiveness' (West-Eberhard 2005a) inherent to each individual's genotype such that the impact of the environment, as well as the individual's behavior, can influence how that individual's phenotype develops. This responsiveness can also be adaptive, e.g. when it 'provides individuals with the flexibility to adjust their trajectory of development to match their environment' (Gluckman et al. 2009, p. 1654). There is thus no one-to-one relationship between an individual's genotype and its phenotype. Rather, a given genotype can produce a range of different phenotypes depending on its interactions with the environment in which it develops. According to West-Eberhard, this plasticity is what can account for the origin of selectable variation within a given population, since genetic mutations will only have effects on development if phenotypes are responsive. This allows her to suggest a 'phenotype- or development-first' view of evolution:

> Development, with its built-in flexible responsiveness to both gene products and environment, is responsible for the *origin* of viable, selectable phenotypic variation…whereas selection explains which variants then spread and are maintained. So evolution is always a two-step process, involving first developmentally mediated variation and then selection resulting in gene frequency change (1998, p. 8419).

Some (rather old) examples of this can be found in the field of ecological developmental biology (or eco-devo). For example, plasticity has been witnessed in frogs whose developmental outcome was contingent upon whether there were predators in the surrounding water when they were tadpoles (Gilbert 2001). Other amphibians are capable of altering the speed of their development depending on the volume of water in the pond in which they develop (2001). This has also been studied in genetically cloned plants that were placed at different elevations. As each plant grew differently at each elevation, showing that the same genotype can express itself differently depending on the environment, it becomes nearly impossible to predict which genotype would grow 'best' without reference to the environment (Lewontin 2001). In humans,

there are plenty of examples of how environmental triggers, such as diet and lifestyle, shape our physiology (bones and muscles), our immune systems, as well as our neurobiology (Gilbert 2001). For example, two identical twins, while sharing exactly the same genes, can have quite different immune systems depending on each individual's interactions with various microbes and other microorganisms as they develop. All of these examples illustrate that an organism's development is a function of the relation between its genes, a multitude of environmental triggers that occur over the entire life history of the organism, as well as random molecular fluctuations within the organism's cells as they develop (Lewontin 2001).

One qualification to mention is that while populations will contain various degrees of plasticity, allowing it to evolve through natural selection (Pigliucci et al. 2006), not all plasticity is adaptive. For example, plasticity is adaptive insofar as it can prepare an individual for future environmental changes, but this preparation can also be problematic if the environment for which an individual is shaped through embryological development is rather different than the post-natal environment (Gluckman et al. 2009). Plasticity can thus leave some individuals more prone to diseases later in life. Moreover, the phenotypic effects of environmental triggers can also influence the behavior and development of the following generation (Bateson et al. 2004). While plasticity entails that the expression of genotypes is context dependent, whether or not this expression is beneficial for the organism also depends on the relation between the phenotype and the environment.

So far, I have only been discussing properties of organisms, but what about species? In Canguilhem's various examples taken from biology, we can find three similar yet distinct ways in which species can express a related form of normativity to the one just discussed. First, there is the now rather common example of color changes in moths in relation to increased industrialization in Germany and England. This change can occur in two ways. First, in captivity, black moths are more vigorous and tend to eliminate the gray ones, whereas in the wild (outside of industrialization) the black moths easily stand out against the light trees and are thus kept to a minimum. However, as industrialization pushed away the birds preying on these moths, the black moths displaced the gray ones (Canguilhem 1989, p. 142). Second, in some cases the increase in industrialization led to more black soot building up on the trees, making the gray moths more prone to being eaten, thereby resulting in a shift towards black moths (Cook 2003). For Canguilhem, this suggests that 'life, using the variation of living forms, obtains a kind of insurance against excessive specialization without reversibility, hence without

flexibility, which is essentially a successful adaptation' (1989, p. 142). In other words, due to the standing variation within the population, i.e. the polymorphism of black and gray moths, the species was able to adapt to the environmental changes.

A second formulation of this idea can be seen when Canguilhem mentions the work of zoologist and geneticist Georges Teissier who suggested that the genes of any given species can vary in relation to environmental changes: 'Within any given species, we must allow for a certain gene fluctuation, on which depends *the plasticity of the species' adaptation, that is, its evolutionary power* (2008, p. 126; emphasis added). While he uses the term 'plasticity' here, he is referring to the adaptability of the species itself. In this passage, he is claiming that changes in gene frequency are related to this 'evolutionary power' or this ability of genes peculiar to a given species to produce different phenotypes through environmental interactions. In relation to the findings of Sorre mentioned above, Canguilhem writes that for 'each function and set of functions there is a margin where the group or species capacity for adaptation comes into play' (1989, p. 170). These examples illustrate a kind of unrealized variability that factors into a species' evolution.

Third, Canguilhem also describes this species-level normativity in terms of the ability of a species to produce novelties:

> a living species is viable only to the extent that it shows itself to be fecund, that is, *productive of novelties*, however imperceptible these may be at first sight. It is well known that species near their end once they have committed themselves to irreversible and inflexible directions and have presented themselves in rigid forms (2008, p. 125; emphasis added).

Through innovations a species generates new phenotypes that allow for new evolutionary paths to be taken and new environmental demands to be met. Without such innovations, species become 'rigid' and as demands are not met, they go extinct.

Together, these different aspects of species normativity allow Canguilhem to distinguish between two kinds of adaptation: one that entails specialization for some given task, but is easily threatened by environmental changes, and one that involves a kind of independence from these environmental constraints and variations[99]. A species will be

[99] 'There is one form of adaptation which is specialization for a given task in a stable environment, but which is threatened by any accident which modifies this environment. And there is another form of adaptation which signifies independence from the constraints of a stable environment and consequently the ability to overcome the difficulties of living which result from a change in the environment' (Canguilhem 1989, p. 262). This quote, quite

considered normal, in the sense of being normative, insofar as it exhibits 'a certain tendency towards variety' (1989, p. 262). This ability of a species to ensure itself against 'excessive specialization' by being open to variation has been described elsewhere in terms of Cope's 'law of the unspecialized', which states that 'founding members of highly successful lineages tend to be "unspecialized" in the sense that they can tolerate a wide range of habitats and climates, and that they do not posses complex and highly specific adaptations to narrow behaviors or modes of life' (Gould 1996, p. 164). Whatever the empirical link between Cope's law and these adaptive properties of species turns out to be, Canguilhem's second definition of adaptation would seem to converge quite well with these phenomena.

While Canguilhem did not provide distinct concepts pertaining to the separate ideas of organismic and species normativity, what he was referring to with species-level examples of normativity seems to be what is now called 'evolvability'. This is related to plasticity in that it also refers to the ability of biological systems to change and is used to account for phenotypic novelties, but here the change is to be understood on a different biological level. Evolvability has been defined as 'the ability of particular features of systems to facilitate change' (West-Eberhard 1998, p. 8417), or simply as the 'ability to innovate' (Pigliucci 2010, p. 561). Of the many possible definitions, Massimo Pigliucci boils down the three main approaches to evolvability to describing (1) heritability (how standing genetic variation is a potential for selection), (2) variability (the propensity of characters to vary in relation to environmental factors), and (3) innovation (the propensity to produce novel structures) (2008a, pp. 75-76)[100]. What evolvability helps to illustrate is that the viability of a species is determined in relation to its ability to produce novel forms[101] (Pigliucci 2008a, p. 76). The questions of evolvability and novel forms in evolution are important in relation to the aforementioned critiques of the Modern Synthesis which argue that while this synthesis described changes in genetic variation, it struggled to explain 'the origin and evolution of phenotypic novelties and organismal body plans' (Pigliucci 2008b, p. 895). By bringing in the areas of development and ecology, the

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possibly echoing Nietzsche's critique of Herbert Spencer in *The Genealogy of Morals* (1992, p. 515), highlights the difference between adaptation as conforming to external conditions and adaptation as the result of the organism's alteration of its environment to fit its needs and values.

[100] The related issues of robustness, modularity and whether evolvability can evolve will have to be set aside (Pigliucci 2010).

[101] In an essay discussing the concept of evolutionary novelties, Pigliucci defines them as follows: 'new traits or behaviors, or novel combinations of previously existing traits or behaviors, arising during the evolution of a lineage, and that perform a new function within the ecology of that lineage' (2008b, p. 890).

concept of evolvability further stresses the importance of phenotypic evolution for contemporary biology.

Each of the three examples found in Canguilhem can be defined according to these different meanings of evolvability. The example of the color changes in the moth population illustrates evolvability as heritability; the example of how species vary by producing different phenotypes in relation to environmental changes illustrates evolvability as variability; and the example of how a species' viability depends on its ability to innovate illustrates evolvability as innovation. In each example, the ability to establish a new norm was said to be a property of the species, thus going beyond plasticity to evolvability.

As a result of these investigations, it is clear that, for Canguilhem, the norms of living beings are plastic because there is no biological non-indifference. While this places the stress on individual organisms, the discussion of evolvability shows that the flexibility of biological norms is also a property that pertains to higher levels, such as species. As such, Canguilhem's account of biological normativity is not wedded to the idea that natural selection must be understood in terms of organism-level properties[102]. The claim, therefore, that normativity is strictly linked to or identified with 'individuality' is simply false.

5. Conclusion

Overall, the critique leveled at Canguilhem by Giroux that has been discussed in this and the previous chapter is helpful in that it brings some novel ideas to bear on Canguilhem's theories, putting them to the test. The main problem with this critique, however, is that it stays on the surface, claiming that Canguilhem's concepts are problematic on a philosophical level, but failing to explore the empirical examples that he gives to demonstrate his concepts. Moreover, by not comparing the scientific studies that Canguilhem discusses with more recent ones, Giroux would seem to imply that what we now know about biology and medicine make whatever findings Canguilhem was appealing to problematic at best, and obsolete at worst. With these two chapters I hope to have shown that Giroux's critique ends up being imprudent on nearly every point. The previous chapter dismantled her critiques regarding what was at

[102] In the aforementioned archive notes, 'Les mathématiques en biologie', Canguilhem clearly stated that the ability to change is a property of life that can be found in both individual organisms and species: 'Vivre c'est se changer. Il y a donc à tenir compte non pas seulement d'une variabilité dans le cadre de l'espèce, mais aussi d'une variabilité propre à l'individu' (p. 28).

stake when Canguilhem analyzed biological individuality and consequently whether it is possible, and even desirable, to transpose the concept of health from individual organisms to (human) populations. In this chapter, I analyzed Giroux's claim that various changes in evolutionary theory, such as multi-level selection, have led to the idea that the individual organism is no longer of central importance, and concluded that this claim is rather problematic in light of a host of other findings in biology. Far from losing its central position originally bestowed upon it by Darwinism, the organism appears to be more central than ever for understanding the nature of natural selection and adaptation. Canguilhem's ideas seem quite tenable after all.

To conclude, I would like to address a possible objection and open a line of inquiry that will be pursued in the next two chapters. First, insofar as Canguilhem's account of normativity shows a species-level property of adaptability (evolvability), would this provide an argument *in favor* of Giroux's appeal to population health? The normativity of a species, its ability to vary, does seem to provide an analogue to organismic normativity, in the sense of being open to multiple norms, which is what Canguilhem equates with health. While this does open the door to such claims, I still find it problematic. As I have already argued, it is questionable whether organism-level properties can easily be transposed to higher levels. Species or populations might be individuals that can evolve, reproduce and even go *extinct*, but it is problematic to say that they are alive[103] or that they have an analogous functional integration as do organisms (except, of course, for those populations that are themselves organisms, which do not seem to be what Giroux has in mind). Without incorporating such properties, the concept of population health is unlikely to be little more than a metaphor.

This leads to the suggestion. By exploring the ways in which Canguilhem's ideas are in line with various biological theories concerning the nature of the organism, does this put us in a new position to use biology to understand health and disease? In other words, if we return to the general debate in philosophy of medicine concerning naturalism and normativism, are we in a better position to clarify how biology could contribute to defining health and disease? From what was explored here, it seems possible to use the concept of plasticity to understand the health of individual organisms and the individuality of health. For example, this phenomenon

[103] By 'alive', I am assuming a proposal such as Michel Morange's (2008a, p. 141), which claims that life is characterized, at the least, by the properties of possessing rather complex molecular structures, which are involved in highly specific catalytic and metabolic reactions, ultimately allowing for self-reproduction. Interestingly, he mentions Canguilhem in relation to the idea that falling ill is another property peculiar to organisms, likely related to the ability of complex living systems to adapt to environmental changes (2008a, p. 177, n. 1).

specifies how environmental factors, behaviors, and collective norms influence the development and expression of an organism's unique genotype and it seems to lend support to Canguilhem's claim that health is relative to individual organisms. Plasticity also ensures that organismic norms cannot be fully understood without reference to the environment and only when the organism is viewed as a 'whole' can one understand the role that individual variation and variability play in discussions of health and disease. Finally, as plasticity illustrates the interplay between biological non-indifference and the environment it would seem to support Canguilhem's claim that health is a matter of biological valuation, experimentation, or 'experience'.

The problem that has to be worked out, however, is how such an account would differ from what is more recently being done in the field of Darwinian or evolutionary medicine, or evolutionary analyses of disease more generally, as these accounts also refer to plasticity. If plasticity is an evolved biological property of living beings, then what does it add to evolutionary accounts that base their definition of disease on the breakdown of evolved biological traits? I have already shown that Canguilhem's account differs from Boorse's, as well as some aspects of the evolutionary or etiological account, e.g. Wakefield, but what needs to be specified is why the evolutionary account is insufficient and how an appeal to plasticity could circumvent some problems in the evolutionary account.

Chapter Five

Health, Disease, and Human Evolution: Past Contexts and Present Organisms

> The physician does not cure *man*, except in an incidental way, but Callias or Socrates or some other called by some such individual name, who happens to be a man. If, then, [he]… recognizes the universal but does not know the individual included in this, he will often fail to cure; for it is the individual that is to be cured.
>
> Aristotle, *Metaphysics*

While much has been written about the recent emergence of the new science of Darwinian or evolutionary medicine, it remains unclear what it adds to our current understanding of the concepts of health and disease. If we are to appeal to biology to develop a more coherent account of health and disease, can evolutionary theory provide us with a conceptual 'foundation' as some have claimed (Nesse 2012)? How can evolutionary explanations of why we get sick help to clarify these concepts? As I have shown in previous chapters, one of Canguilhem's enduring claims is that health and disease cannot be properly understood without referring to the organism-environment relation. An interesting question that evolutionary accounts raise is whether some environmental relations play a stronger explanatory role than others. If health and disease are environmentally relative, why not appeal to those past 'normal and natural' environments in which humans evolved so as to better distinguish health from disease? The main aim of this chapter is to see what is at stake in Darwinian medicine so as to determine what it can contribute to the philosophy of medicine debate in general.

First, I will mention a few of the main claims and insights of Darwinian medicine and draw out some potentially problematic presuppositions. While an appeal to evolution is meant to provide a more objective description of what is 'normal and natural', it is unclear whether such descriptions are as informative for medicine as is often suggested. Second, I will examine three evolutionary approaches to disease: a 'Darwinian' one, Jerome Wakefield's hybrid account, and an approach based on homeostasis. As we will see, each approach struggles to address the problem that I have been exploring in this dissertation, i.e. how biological norms are always relative to specific ecological, social, and developmental conditions, making 'individuality' an inescapable problem for medicine (Childs et al. 2005). I will conclude by claiming that while each of these approaches tries to establish the medical relevance of past evolutionary norms, they seem insufficient to help us conceptualize of health and disease. By

stressing the role of the environmental and organismic context, as Canguilhem suggests, we might need to rethink the project of making evolutionary biology 'foundational' for medicine, especially when it comes to delineating the normal and the pathological. In the next chapter, I will consider a different way to understand Canguilhem's theses in terms of some physiological and developmental properties of living beings and will return to the problem of grounding medicine in evolutionary biology.

1. Some Insights and Limits of Darwinian Medicine: The Past Ain't Through With Us

While it might seem somewhat commonplace today to suggest that the insights of biology can be applied to medical thinking, the history of how these fields converged suggests that such an application has not always been evident. The roots of the current developments of Darwinian or evolutionary medicine[104] can be traced back to the 19th century where evolution was used to explain disease virulence and variation (the evolution of diseases), as well as the complex transmission patterns of hereditary diseases (diseases of evolution), the latter accounting for what are now called diseases of civilization (Méthot forthcoming). As such, evolutionary biology seemed to provide a useful framework to understand disease etiology.

At the end of the 19th century and the beginning of the 20th century these explanations gained momentum during what is called the period of 'medical Darwinism' (Zampieri 2009), a time which saw a large increase in publications in leading medical journals that mentioned 'Darwinism' or 'evolution'. This time also saw a rising interest in eugenics mainly due to the work of Francis Galton and Karl Pearson. Following the Second World War, and the growing link between Nazism and eugenicist projects, this interest in combining evolutionary theory and medicine became rather suspect. As a result, those interested in carrying out such a project have had to explicitly distance themselves from these influences (e.g. Nesse & Williams 1994, p. 11; Rühli & Henneberg 2013). Some other historical changes in the second half of the last century, such as the rise of a more molecular approach to understanding disease, the spread of simplistic (and often erroneous) interpretations of various ideas in sociobiology and

[104] Méthot (2011; forthcoming) makes a helpful distinction between what he calls Darwinian medicine, which focuses on the origins and medical significance of human adaptations as well as their hereditary transmission, and evolutionary medicine, which focuses on those factors which shape the evolution of infectious diseases. Throughout this chapter, I will be discussing 'Darwinian' medicine. However, as many recent reviews tend to mix these interests when referring to 'evolutionary' medicine (e.g. Gluckman et al. 2011; Stearns 2012; Nesse et al. 2010), possibly preferring 'evolutionary' over 'Darwinian' (e.g. Brüne & Hochberg 2013), the distinction is not always so clear.

evolutionary psychology, and even the religious backlash to evolutionary theories, also mitigated the influence of evolution on medicine (Gluckman et al. 2011). Such a turbulent past, however, has not halted the attempts to bring these two fields together. Since the dawn of the new science of 'Darwinian medicine' in the 1990s there has been a steady increase in the interest to combine these fields, as witnessed by various textbooks and journals dedicated to evolution and medicine (e.g. Trevathan et al. 1999; Stearns & Koella 1999/2008; Gluckman, Beedle & Hanson 2009; *The Evolution & Medicine Review* website created in 2008; *Evolution, Medicine, & Public Health*). In what follows, I will discuss some insights of Darwinian medicine, as well as its limitations, as these will help to clarify the implications for understanding the concepts of health and disease. The first deals with our evolved susceptibility to disease, the second deals with how past norms help to explain present problems.

Since its conception by biologist George C. Williams and physician/psychiatrist Randolph Nesse, one broad insight of Darwinian medicine is that we have been asking the wrong question concerning the relation between evolution and disease. We should not be asking why it is that evolution does not select out the bad aspects of our biology so as to shape us for health, but rather why it is that evolution has left us so vulnerable to disease[105] (Nesse & Williams 1994). As natural selection is purported to optimize survival and reproduction, often at the expense of health and longevity, the organism is better understood as a bundle of compromises and trade-offs, making disease an expected consequence of our evolutionary past (Nesse 2011). By providing evolutionary explanations for disease vulnerability, Darwinian medicine thereby aims to 'demystify' disease etiology.

There are many sources of this vulnerability: the arms race between pathogens and their hosts (with pathogens leading the war), the potentially harmful effects of novel environments, evolutionary trade-offs, evolved bodily defenses, harmful mutations, selection acting on reproduction rather than health, and the evolutionary constraints of a given species (Nesse 2012). Knowing that we are not 'designed' for health, an evolutionarily-informed perspective would allow us to make predictions regarding the medical significance of biological processes or traits. For example, various (seemingly) pathological reactions, such as the body's reaction to pathogens, defense mechanisms, fevers, and even mental illnesses, could be understood in terms of their possible adaptive[106] advantage (Nesse & Williams 1994). However, what remains

[105] Nesse (2005) also describes this approach as 'maladaptationism'.
[106] I will set aside the issue of 'adaptationism' in what follows as this has already been discussed by others and would open up too many issues (c.f. Andrews et al. 2002; Lewens 2009; Valles 2012).

to be seen is whether such broad vulnerabilities are useful for clarifying the concepts of health and disease, and whether the resulting predictions are more useful than the typical physiological explanations used in medicine. I will return to these issues shortly.

Possibly the most theoretically significant aspect of Darwinian medicine is its stress on 'backwards-looking explanations' (Méthot forthcoming). As such, it employs an etiological account of biological functions as discussed in chapter 2. In other words, it appeals to past environmental conditions, such as the environment of evolutionary adaptedness (EEA), to help explain our present functions and dysfunctions, e.g. many of the 'diseases of civilization' from cancer to addiction seem to stem from having 'deviated' from the EEA. The EEA concept comes from the psychoanalyst John Bowlby's work on attachment theory in the 1960s and 1970s (foreshadowing some ideas in evolutionary psychology) and refers to the ecology and period of time in which the adaptations which now characterize the human species were selected[107] (Foley 1997). The environment is typically that of the African savannah and the time is the Pleistocene, which extends from roughly 1.8 million to 10,000 years ago. Through natural selection, humans were adapted to the 'Stone Age lifestyle' consisting of living in small groups, practicing hunting and gathering, getting lots of exercise and sun, and eating wild foods (Eaton et al. 1988). It is even argued that all of the traits that make us 'fully human' were selected during that time, such that if 'we could magically transport babies from that time and rear them in modern families, we could expect them to grow up into perfectly modern lawyers or farmers or athletes or cocaine addicts' (Nesse & Williams 1994, p. 134).

Moreover, it is claimed that there has not been sufficient time or selection pressure for evolution to adapt humans to the modern environment with its high-density populations, troubling socioeconomic conditions, insufficient exercise, artificial lighting, and the presence of highly processed, energy-dense foods: hence the many 'diseases of civilization'. According to one of its critics, the strongest version of this view (also shared by evolutionary psychology, e.g. Tooby & Cosmides 1990) suggests that 'human beings are not adapted to any of the environments that have occurred since the close of the Pleistocene' (Irons 1998, p. 196), resulting in a sort of adaptive lag. As Darwinian medicine views natural selection as operating

[107] While the concept of the EEA has been highly criticized from various perspectives, even by proponents of Darwinian medicine (e.g. Strassmann & Dunbar 1999), the idea of appealing to our evolutionary origins to explain current diseases remains a central tenant of this theory.

mostly, if not solely, on genes, rather than individual organisms or groups[108] (Nesse & Williams 1994, p. 15), this stress on the lack of time for recent genetic adaption becomes central since most of our genome seems to have remained largely the same since the EEA.

Consequently, proponents of this view argue that the modern 'abnormal' and even 'unnatural' environment is a deviation from our 'normal' or 'natural' environment that 'we evolved to live in' (Nesse & Williams 1991, pp. 14-15). 'This view, thus, has normative implications regarding what is normal and abnormal behaviour in terms of health, and suggests that a number of diseases result from changes in social and physical environmental conditions broadly construed' (Méthot forthcoming, p. 21[109]). This is not to imply that there were no diseases or problems in the Stone Age: high infant mortality rates, infanticide, lack of protection from infectious diseases, and climatic instabilities are explicitly acknowledged (Nesse & Williams 1994, pp. 136-137). However, by specifying the conditions we 'evolved to live in' we might get a better grip on why certain diseases are becoming more prevalent in spite of the many social and technological advances in medicine and hygiene since the advent of 'civilization'.

The limitations of appealing to the EEA to help explain current behavior and diseases are numerous. For example, it has been argued that we simply lack adequate information regarding our ancestral environment to be able to make such strong claims regarding what is 'normal' for modern humans and the known variability among hunter-gatherers, both past and present, also makes such appeals dubious[110] (Foley 1997; Dupré 2012). In other words, according to these critics, there has been much variation in lifestyle characteristics and behaviors during and since that time, making the genetic links between the EEA and modern humans less strong than is typically thought (Foley 1997).

While there are epistemic problems regarding these backwards-looking explanations, there are also empirical issues. For example, since the EEA, the social and technological

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[108] Though, in a more recent review co-authored by a wide range of Darwinian and evolutionary medicine proponents, multiple levels of selection are acknowledged (Nesse et al. 2010).

[109] As Méthot's essay has not yet been published, the pagination used throughout this chapter refers to the unpublished manuscript provided by the author.

[110] There is also the historical issue of the role of politics and social changes in shaping lifestyles, such as how the dietary shifts throughout the 20th century in the U.S. and some European countries away from healthy animal fats and oils to vegetable oils, sugars and grains, is likely contributing to the prevalence of many diseases (Taubes 2008). Moreover, the fact that lower income groups tend to be disproportionately affected by such changes also suggests an economic aspect of this problem (Dupré 2012). Thus, while it is true that our modern dietary practices 'deviate' from ancestral conditions, the problem would be suggesting that such deviations are the expected results of how our biological proclivities can be maladaptive while downplaying the more proximate political and economic causes.

changes, first regarding agriculture and then subsequent demographic changes, are likely to have *accelerated* various aspects of human evolution. Many examples arise in the area of gene-culture co-evolution (Richerson & Boyd 2005) and niche construction, such as changes in genes for lactose persistence, for regulating starch digestion (salivary amylase genes), for offsetting the consumption of carcinogen-containing cooked foods, a genetic resistance to infectious diseases such as malaria, and the role of diet and current technology in altering encephalization, to name only a few (Powell 2012). It has recently been argued that there have been hundreds of genes under selection within recent human populations (Hawks et al. 2007). Furthermore, the very appearance and development of medicine as an institution could also be cited as an example of how humans structure their environment as a form of adaptation which removes certain selection pressures and speeds up evolution (Canguilhem 1989; Laland & Brown 2006). As I discussed in the previous chapter, the plasticity of some traits allows for adaptations to novel environments which can then become genetically assimilated, thereby enhancing a species' evolvability (West-Eberhard 2003). It is likely that such processes drove human evolution (Powell 2012). Thus, to claim that we are only adapted to the EEA conditions that made *Homo sapiens* 'fully human' and that it is primarily our 'unnatural' modern environment that plagues us would be to commit what Canguilhem refers to as the 'illusion of retroactivity according to which original good is later evil kept in control' (1989, p. 241). From genes to culture, humans have never stopped adapting to environmental changes and despite our evolved vulnerabilities, we are matched in many ways to the modern environment we have created.

> Thus, saying that the EEA is the normal and natural environment of the human species by no means entails that the phenotypes and genotypes of *Homo sapiens* were "designed" for or "optimally" adjusted to their Stone Age surroundings. All it can possibly mean is that some variants of particular traits scored higher in terms of fitness than others did in that particular environment. But just as some traits that evolved during the Pleistocene era are now maladaptive, others may be even better adapted today, as amply demonstrated by the reproductive success of the human species (Méthot forthcoming, p. 22).

The EEA might provide some 'adaptively relevant' (Irons 1998) information (*some* aspects of nutrition, exercise, socialization, etc.), but the conditions for producing health and disease during the Pleistocene are not the same as those present in this sliver of the Holocene. While

parts of our genome might have gone largely unchanged, many things have changed epigenetically, behaviorally, culturally, ecologically etc., all of which continue to shape what it means to be human, let alone to be healthy or diseased.

Some attempts have been made to address these shortcomings, such as the more refined approaches to understanding the issue of 'mismatch'[111]. While the main idea has been around since the inception of Darwinian medicine (e.g. Eaton et al. 1988; Nesse & Williams 1994, p. 9), it has been elaborated in a more 'holistic' approach with the help of developmental biology, providing a developmental origin of health and disease to complement the evolutionary etiologies (Gluckman & Hanson 2006; Hanson & Gluckman 2008; Gluckman, Beedle & Hanson 2009; Gluckman et al. 2009; Gluckman et al. 2011). The main idea is that an increased 'disease risk can emerge, because the individual has been exposed to an environment that is beyond their evolved capacity to adapt, is entirely novel or that poses a challenge' (Gluckman et al. 2011, p. 253). Such a 'mismatch' can be described on two levels: the 'species design' and development (with the latter being a specific instance of the former).

On the one hand, by specifying the EEA, modern diseases can be partially explained by the lack of adaptation or mismatch on the level of the genes which characterize the 'original design' of *Homo sapiens* (Nesse 2001; Eaton et al. 2002). Every cultural advancement creates new problems: population density creating new diseases and vectors for disease transmission; clothing leading to vitamin D deficiencies; agriculture and subsequent dietary changes (such as the consumption of processed foods) leading to vitamin C and protein deficiencies; myopia as a result of childhood reading and classrooms; various cardiovascular issues related to sedentary lifestyles; new antibiotics leading to more virulent strains of pathogens, etc. (Nesse & Williams 1994). As a species, then, we have fallen outside of our evolved 'comfort zone' and our strategies to cope and compensate are simply too weak for us to be able to adapt to these changes (Gluckman & Hanson 2006, pp. 42-48).

On the other hand, due to developmental constraints there can also be a mismatch whereby an individual organism that received information concerning its possible future environment while it was a developing fetus finds itself in a rather different environment. For example, a fetus from a malnourished (or stressed) mother or a newborn in a malnourished environment can undergo some lasting epigenetic, physiological, and anatomical changes during its development and early life history. These changes can leave the individual with a

[111] A rather similar view discussing evolutionary 'discordance', rather than mismatch, can be found in Boaz (2002).

higher risk of disease when the later environment is rather different (Gilbert & Epel 2009, p. 256-262). This mismatch between the anticipated environment and the actual environment can increase the risk of diseases such as heart disease, obesity, hypertension, etc. (Gluckman et al. 2011). Ultimately, both types of mismatch imply that it is because we are living in an environment and leading lifestyles that are rather different from that which characterized the large majority of our evolutionary past, to which a good portion of the human genome was adapted or matched and which places constraints on our development, that we are vulnerable to many diseases.

While many of the limitations pertaining to the role of the EEA also apply here, it is important to note that this developmental aspect allows for some of these limitations to be mitigated. For example, this aspect describes organism-level adaptations as a kind of 'fine-tuning' of the organism with its environment: 'we can envisage the genotype as providing the crude settings for the organism's development of its mature phenotype. Epigenetic and other forms of developmental plasticity drive the phenotype towards a better match' (Gluckman & Hanson 2006, p. 199). This allows not only for a more theoretically cogent perspective regarding the relation between humans and their changing environments, but also makes an understanding of disease more contingent upon historically varying developmental and ecological factors (Gilbert & Epel 2009). As we saw above, the supposed slowness of evolution is claimed to place constraints on what humans are biologically capable of, thereby making us susceptible to various diseases. A potential consequence is that this claim tends to lead those promoting it to downplay the role of the environment for understanding 'human nature' (e.g. Pinker 2002). However, the argument of Gluckman and Hanson (2006, pp. 202-204) suggests that it is precisely because of these various constraints that non-genetic factors, from epigenetics to behavior and ecology (e.g. social and technological changes), are crucial for understanding recent (and future) human evolution.

Despite these benefits, it remains to be seen what can be concluded regarding the nature of health and disease from the concepts of 'match' and 'mismatch'. On the one hand, Gluckman and Hanson write the following about these concepts:

> If the organism is *matched* to its environment, then we suppose that it has become suited by both evolutionary and developmental processes to be so. … The greater the degree of match between an organism's constitution and its environment, the more likely the

> organism is to thrive; the greater the degree of mismatch the more the organism has to adapt or cope' (2006, p. 11).

On the other hand, in their textbook on evolutionary medicine, Gluckman, Beedle and Hanson write that a mismatch is a 'failure to adapt because of temporal or structural constraints' that 'may lead to pathology' (2009, p. 5). Thus, while being matched to one's environment implies an adaptive adaptation, it is not clear whether all matches ensure or entail health. It is similarly unclear at what point a mismatch entails disease. It certainly seems possible that individuals could be matched and yet diseased, or mismatched and yet healthy. Moreover, while the developmental approach incorporates the 'fine-tuning' capacities of organisms, it is still a generalization based on average fitness consequences that was developed to explain disease etiology and certain epidemiological observations. As such, while they refer to the 'organism' as being matched or not, thriving or not, fitness still refers to a property of groups, not individual organisms (as I discussed in the section on functions in chapter 2). It thus remains an open question as to whether match and mismatch are sufficient to explain health and disease in individual organisms.

While the potential of merging evolutionary theory and medicine lies not only in its theoretical implications, but also in its clinical applications, the main proponents continually stress that the primary goal is not necessarily to provide direct clinical guidance, but rather to help guide research: 'evolution helps doctors make sense of why a disease exists at all, what environments increase the risk, and how treatments work' (Nesse & Stearns 2008, p. 31). That being said, many practical applications have been suggested, such as questioning the efficacy of tampering with the body's evolved mechanisms due to the possibility that they have adaptive benefits. For example, if fever and the mechanisms for iron withholding are viewed as evolved adaptations to fight infections, then it might be good to let fevers run their course and to avoid iron supplementation while ill (Nesse & Williams 1994). It is the assumption that the defense mechanism could have adaptive benefits which shapes how it might be approached clinically[112].

[112] More recent examples which depend less on such 'adaptationist' explanations suggest that reconstructing pathogen phylogenies can aid in understanding the origins of diseases such as HIV and help to predict how viruses will spread in epidemics; evolutionary principles can help to explain antibiotic resistance and even suggest possible ways to combat it; research into how cancer cells emerge and evolve is shaping new cancer treatments; and recent understanding of the importance of gut microbiota for overall health and disease is creating new treatment options for a variety of diseases (for these and more see Nesse & Stearns 2008; Stearns 2012). While some approaches to evolutionary medicine remain more relevant to medical research than the clinic, the potential for practical benefits remains an open question.

As was mentioned above, it is still an open question as to whether evolutionary explanations regarding why we get sick will significantly supplement more proximate physiological explanations. For example, the claim that the treatment of fever should be questioned due to the potentially adaptive benefits that a fever induces (e.g. elevated body temperature so as to fight off an infection) has been criticized for not being attentive enough to how the individual's condition, coupled with their sex, age, lifestyle, overall health (and environmental factors) etc., are likely to be more important for determining treatment than evolutionary considerations (Valles 2012; Méthot forthcoming). One can question the treatment of fever without referring to evolutionary adaptations (e.g. Goldstein 1995, p. 333), and even if we know the adaptive story of a given phenomenon that does not in itself tell us anything about when and how to treat it. In other words, while the ultimate explanations that evolutionary biology suggests for *why* we get sick might help to pose certain hypotheses for medical research, some argue that they have little to no 'epistemic value in clinical practice' (Cournoyea 2013, p. 43). The proximate physiological and pathophysiological explanations that provide mechanistic descriptions of *how* the body is functioning differently are the final arbiters regarding clinical interventions (e.g. whether to treat *this* fever in *this* particular patient). To be useful, evolutionary considerations 'must be determined and confirmed by proximate physiological knowledge' (2013, p. 45). It seems, then, that the proximate causes pertaining to the individuality of the patient in a given environment, together with the doctor's expertise, play stronger determining roles in whether a given treatment should be given[113].

While evolutionary biology might provide some sort of general framework to understand disease vulnerability and disease etiology (Nesse et al. 2010), the many limitations mentioned here call into question the 'foundational' status of evolution for medicine. The next section will explore some of the epistemological implications of how health and disease are conceptualized within this field. Can such insights into disease etiology clarify disease ontology? If modern medicine is moving more towards developing a 'science of the individual' (Childs et al. 2005), can Darwinian medicine adequately account for the individuality of health and disease?

[113] Nonetheless, I feel that the pessimism regarding the place of evolutionary explanations in medicine is sometimes overstated. In the area of dietary suggestions for treatments of metabolic mismatches, for example, findings from anthropology, physiology, and molecular biology seem to increasingly converge (Cordain et al. 2001; Lindeberg et al. 2007; Musso et al. 2011; Sponheimer et al. 2013).

2. Health and Disease Concepts in Darwinian Medicine: Historicizing Normality?

Amongst the main proponents of Darwinian medicine we can find two discussions of the disease concept: one in Nesse (2001) and another in Gluckman, Beedle and Hanson (2009). Oddly, these approaches fail to mention one of the most important evolution-based approaches to defining disease: Jerome Wakefield's (1992) 'harmful dysfunction analysis' (HDA). In this section I will ask how and whether these three evolutionarily-informed approaches help to clarify our understanding of disease. While the approaches by Nesse and Gluckman, Beedle and Hanson are both 'Darwinian' in that they seem tied to an etiological understanding of biological functions (as discussed in chapter 2), there are differences between them that need to be drawn out as each has its own weaknesses. Wakefield's approach could be seen as a way to overcome some conceptual problems related to these approaches by bringing in social values, but this also has its shortcomings. Insofar as all three etiological approaches run into considerable difficulties when it comes to conceptualizing health and disease, the usefulness of evolutionary theory for clarifying disease ontology will be once again called into question.

In his 2001 article entitled 'On the Difficulty of Defining Disease: A Darwinian Perspective', Nesse interestingly suggests that the very concept of disease initially arose out of the human experience of abnormality as an undesirable state, providing an explanation for why disease is often linked with value judgments (2001, pp. 37-38). However, by appealing to various insights of evolutionary biology that help to explain biological functions and dysfunctions, he claims that there can be a 'solid underpinning to these values' (2001, p. 39). He argues that those 'deviations that negatively influence the ability of these [species-typical] mechanisms to carry out their usual tasks are pathological. This is objective and depends on no social input' (2001, p. 44). Therefore, regardless of the origins of the disease concept in negative valuations, an objective approach to understanding disease is possible by referring to what is 'usual' for our species[114]. In this naturalistic view, then, disease can be objectively understood as a dysfunctional or disadvantageous deviation from species normality (2001, p. 41).

One way of understanding this is that with Nesse's approach the determination of the line between the normal and the pathological initially seems rather close to Boorse's (1975,

[114] Stearns, Nesse and Haig (2008, p. 13) mention that when it comes to understanding variation medicine often involves normative concerns, such as whether the variation is desirable, whereas evolutionary biology is not concerned with normal and abnormal variation and that this explains the tension between the aims of medicine and the forces of natural selection. As one of Nesse's points in the 2001 essay is to describe disease objectively, the suggestion is that evolution might provide a foundation for this normativity.

1997) biostatistical account that views the standard for normal (i.e. species-typical) functioning as pertaining to an evolved species 'essence', which is relative to sex and age groups. In both, the 'normal is the natural' and health entails a *conformation to* species design (Cournoyea 2013, p. 49). Yet by appealing to the dysfunction of evolved adaptations, which are themselves always relative to a given environment, Nesse situates himself more within the 'etiological' account of function/dysfunction whereby a given mechanism or trait is considered dysfunctional when it fails to perform what it was naturally selected to do in past environments (2001, p. 41). While normality is no longer determined by abstract physiological regularities, by arguing that 'the vast majority of traits are the same in all normal people' (Nesse 2001, p. 44) – traits (i.e. the genes for them) which were selected during the EEA – he implies that present normality finds its explanation in our evolutionary past. While he mixes both views (biostatistical and etiological), it seems reasonable to interpret his approach as primarily an etiological one.

The benefits of an etiological account are that it helps to explain how traits have come to be widespread in a given population and can help to distinguish accidents from functions. However, as we saw in the previous section, this happens at the cost of potentially overemphasizing the role of the past environment in determining what is currently 'normal and natural'. Nesse consequently runs into the typical problems facing etiological accounts, e.g. explanations of traits that need not appeal to natural selection, the issues of spandrels and vestigial organs, and a strong reliance on fitness. Nesse claims, for example, that 'we can assess whether a state is pathological or not by determining its deviation from the usual and its effects on reproductive success' (2001, p. 42).

While one could object from the start that basing health and disease judgments on fitness is problematic as it conflates the concerns of biology and medicine (Woolfolk 1999; Gammelgaard 2000), it is also problematic for other reasons. For example, there is the hypothetical example of a mutation that improves some biological function but leaves the organism sterile (Schaffner 1993). As this mutation is not a result of natural selection and could not be fitness-enhancing, Nesse's account would either struggle to even call it a function or would consider it to be pathological, despite its positive effects. However, as medical judgments are concerned with the current contributions to the maintenance of an organismic system, labeling such a mutation a non-pathological function would seem more helpful.

An interesting issue also arises on the other extreme, e.g. Nesse's example of a gene that increases reproductive fitness but also causes manic-depression (2001, p. 42). As it would likely

become nearly universal within a population, its normality or abnormality seems to depend on the approach we take. Relative to the given population and even to fitness-effects (i.e. from a 'gene's eye view'), it would be 'normal', whereas relative to past species norms, it would be abnormal. By implication, those 'deviants' without such mood swings who are species-atypical and have reduced fitness would be abnormal when compared to the present norm, but normal when compared to past species norms. While this poses an interesting problem for some biostatistical accounts, there is a possible reply if the context is better specified. Despite the potential fitness effects[115], one could argue that such a condition could still be pathological (even if statistically normal) for various reasons, e.g. leading to feelings of hopelessness or worthlessness, fatigue, insomnia, and potentially eroding social relations. The 'deviants' would be normal as their personal experience and social relations go unaffected (even if they are reproducing less). Since an evolutionary approach would struggle regarding the previous example of a beneficial-yet-sterilizing mutation, and since there is a seemingly convincing reply to Nesse's example, it seems that etiological explanations are unnecessary to understand these issues.

A similar conclusion can be reached when looking at the issue of distinguishing normal and abnormal variation in the case of disability. Nesse's definition would likely force him to call disabilities or impairments such as myopia, blindness, color-blindness, deafness or abasia diseases either because they involve dysfunctions of evolved bodily mechanisms or because they might have some maladaptive effects, i.e. undermining reproductive fitness. In either instance they would be 'disadvantageous' deviations from normal functioning. Yet it can be argued that such conditions entail a different functional integration, allowing for different functional possibilities, and as such are 'normal' in their own way. In other words, disabled organisms might be able to function through their own atypical mode of functioning (Amundson 2000). Moreover, whether they need to be pathologized might be better determined relative to what they mean for individual organisms in their social and technological environments (Dupré 1998). As we have seen, Canguilhem argues that myopia could be considered abnormal relative to those activities where being far-sighted is needed, but normal in other environments. This need not imply desirability, but would suggest going 'beyond the body' to understand normality such that the 'disadvantage that attaches to blindness and paralysis derives not from

[115] In this hypothetical example, it seems possible to assume that such individuals might be capable of engaging in sexual behavior more often than those without this condition, thereby increasing their reproductive fitness, while also undermining general socialization processes in other ways.

the atypicality of one's biology,' even if defined etiologically, 'but from the absence of appropriate tools and environments' (Amundson 2000, p. 47). While it can be conceded that in the EEA, such disabilities would likely have been detrimental to survival and thriving of most kinds and could thus be considered pathological in that environment, a changed environment could actually render these conditions viable and allow organisms to establish a norm there. Consequently, judgments based on 'disadvantageous deviations from species norms' seem insufficient to distinguish the anomalous from the abnormal.

A more sophisticated etiological account has been developed by Jerome Wakefield in terms of what he calls the 'harmful dysfunction analysis' (1992; 2007). According to this analysis, the judgment that something is a disorder requires that two conditions are met. First, there must be a dysfunction defined (etiologically) as the breakdown of a mechanism to perform its naturally selected function. Second, there must be harm as defined relative to a society's standards. One interesting benefit of this approach with regards to the issues raised here is that it would allow for more context-relative judgments to be made regarding disorders. While references to the EEA, for example, are necessary to understand whether something is a function or not, this is insufficient to determine whether someone has a disorder. As such, Wakefield would likely agree with my examples regarding disability by arguing that where there is no socially-determined harm regarding those conditions, they need not be considered disorders even if they do involve evolutionary dysfunctions. We would disagree, however, in terms of whether something like dyslexia should be a disorder even in literate environments when the individual does not share the social value of reading (Wakefield 2005). We would also disagree in the case mentioned in chapter 2 concerning someone from Africa with seasonal affective disorder moving to a higher latitude and potentially improving their fitness (De Block 2008). For Wakefield, such an individual would have a harmless dysfunction, but not a disorder, whereas I would agree with De Block that in the new environment there is no dysfunction. This would follow from the ecological account of function discussed in chapter 2.

Without revisiting the same typical objections that I mentioned above regarding spandrels and vestiges etc. (see Murphy & Woolfolk 2000a,b), I want to point to another problem that is peculiar to Wakefield's analysis, i.e. the problem of normal variation[116] (Lilienfeld & Marino 1995). While one of the supposed benefits of the HDA is to be able to

[116] The following is a condensed argument that comes from De Block and Sholl (forthcoming) 'Harmless Dysfunctions and the Problem of Normal Variation'.

distinguish accidents from genuine dysfunctions, e.g. being illiterate due to an underlying dysfunction rather than due to not having learned, a problem arises when we are dealing with variations that exist along a continuum, an issue that is quite common. This can be demonstrated by looking at how some suboptimal variations that can entail fitness reductions, e.g. variations in hypotension, need not be considered diseases. Of course, Wakefield's analysis can account for the extreme end of the spectrum, e.g. failures in autonomic functioning, but this is trivial. The real issue is whether he can draw the line between suboptimal hypotension and dysfunctional hypotension without reference to the harm it causes. This is important because Wakefield claims that no matter how harmful a given condition is, it is not a disorder if it is 'part of the way we are biologically designed' (2010, p. 343). Harm, for Wakefield, cannot be used to distinguish the suboptimal from the dysfunctional. This position, however, leads him into a trap. If he claims that all suboptimal hypotension is dysfunctional since it would be fitness-reducing, then he goes against most biological analyses of function for which not all suboptimal variations are dysfunctions (in part because natural selection cannot weed out all suboptimal traits). If he claims that it is harm that determines when the suboptimal becomes dysfunctional, then he undercuts the very distinction between harm and dysfunction that his analysis is based on.

This latter approach, i.e. claiming that the suboptimal becomes dysfunctional precisely when it is sufficiently harmful for the individual, seems to better capture medical intuitions since it is the given individual for whom the harm is problematic or not. Moreover, examples of these 'borderline' cases are not uncommon, but could presumably be found in all conditions that are matter of degree, e.g. those beginning with the prefix 'hypo' and 'hyper'. At the limits of the normal range, precisely where medical judgment is needed and where conceptual analysis is put to the test, Wakefield cannot distinguish the suboptimal from the dysfunctional without assuming that it is harm that will determine when this line is crossed. Consequently, if we add this problem to the typical ones facing etiological accounts, Wakefield's HDA does not seem to fare much better than Nesse's Darwinian perspective.

A third 'Darwinian' approach to understanding disease can be found in a recent textbook by Gluckman, Beedle and Hanson (2009), *Principles of Evolutionary Medicine*, where they also show how evolutionary insights challenge our conception of disease. One of these insights is the need to contextualize disease judgments: 'Definitions of normality, abnormality, and disease are not absolute and are influenced by the environmental context of the individual

and the individual variation in phenotype' (2009, p. 259). For example, while it might be statistically 'normal' for humans to be incapable of digesting lactose, whether lactose intolerance should be considered a disease seems to depend on the environment to which an individual is adapted or 'matched' (2009, p. 5). While the authors do not use such examples to develop a clear definition of disease, an implicit definition can be extracted from their text.

On many occasions disease is viewed as a disruption of our evolved *homeostatic* capacities, most likely (or typically) due to living in an environment to which we are not properly matched[117] (2009, p. 7), such as one containing dairy. It is this mismatch between 'the human capacity to maintain metabolic homeostasis and the modern energetic and nutritional environments', for example, that helps explain the recent rise in diseases like obesity and type 2 diabetes (2009, p. 192). If the mismatch disrupts our evolved homeostatic capacities it will produce disease, and conversely matches facilitating the maintenance of homeostasis would entail health. While this link is not made explicitly by these authors, focusing on homeostasis would help to overcome some of the limitations of Nesse's approach, e.g. by better accounting for organismic adaptive responses to particular environments. It would also provide a way to address the earlier problems of relating match and mismatch to health and disease. Viewing health as homeostasis has even been developed along naturalist lines in terms of the evolved mechanisms of intercellular and organismic homeostasis which refer to how an organism as a whole – relative to species, gender and age groups – performs in a given environment[118] (e.g. Ananth 2008).

As homeostatic regulation is a property of all living organisms, it is plausible to use it as a guideline to define health and disease. However, it still suffers from a few interesting conceptual limitations: the phenomenon of pathological homeostasis, the role of allostatic bodily responses, and the relation between the norms of bodily systems and changing demands.

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[117] In this view it is unclear whether this is a definition of disease or simply a stress on an etiological aspect. In other words, it is unclear whether disease *is* a homeostatic disruption or something else which *results in* such a disruption. While the section of the book from which this idea is taken is entitled 'What is disease?' (Gluckman, Beedle & Hanson 2009, pp. 4-8), the concern seems to be more etiological than conceptual. However, this stress on homeostatic disruption would capture the more 'holistic' aspect of Gluckman, Beedle and Hanson's account and so is worth pursuing. There are similar references to homeostatic reactions and disruptions in Gluckman and Hanson (2004) and Gluckman et al. (2011).

[118] Ananth provides the following evolutionary-homeostatic concept of health: 'an organism – within a certain species, gender, age group, and environment – is in a state of health if and only if its relevant parts and overall behavioral activities have and retain evolved functional propensities to secure dual-homeostasis, which in turn confers a survival enhancing functional propensity on the organism as a whole' (2008, p. 196).

As this 'homeostasis' approach comes closest to Canguilhem's ecological account, discussing its limitations will help to show what is at stake in trying to defend Canguilhem's account.

The first and possibly most severe problem is that homeostatic mechanisms do not always work to preserve the health of the organism. In other words, in some conditions the body could very well be performing homeostatically, according to evolved norms, while maintaining a pathological state. This phenomenon whereby the body preserves a pathological state has been called 'pathological homeostasis' (Bernard-Weil 1999). It seems to counteract treatments to various diseases such as diabetes insipidus, Cushing's syndrome, SIADH (an excessive release of an antidiuretic hormone), and cancer (Bernard-Weil et al. 1999), and it might be more common than previously thought. It is defined as the pathological state in which 'the body is "looking for" cancelling the therapeutic effect, in the same manner it was "looking for" cancelling the stress effect upon the body regulations in physiological states (with different types of adaptation and in general reversion to the initial state)' (Bernard-Weil 1999, p. 25). Such paradoxical states could be described in terms of what Canguilhem calls a norm with a repulsive value, one that resists change and simply maintains a current state of equilibrium (1989, p. 206). Such norms are 'stabilizing or normality-seeking' (Trnka 2003, p. 431), and it is the rigid maintenance of this norm that can become pathological. This should become clear with some examples.

The phenomenon of obesity has been described in terms of homeostatic imbalance, e.g. an imbalance in terms of bodyweight regulating mechanisms, or an insensitivity to feeding conditions, likely due to underlying metabolic problems (Oliver et al. 2013). Obesity could become pathological, then, when it entails the disruption of our evolved mechanisms for regulating bodyweight (coupled with leptin and insulin resistance), which in turn produce a suite of other homeostatic disruptions, such as cardiovascular disease or diabetes. However, it is also possible to show that as bodyweight rises, the body will try to maintain this new set-point for weight. In doing so, the body will resist attempts to lose weight (Heo et al. 2002). Various bodily processes, in this example, operate such that they *preserve* the potentially pathological norm, rather than trying to reestablish a healthy physiology and they do so in the same way that they initially resisted changes prior to the onset of obesity (partly explaining why many

weight-loss diets are so difficult to sustain). Homeostasis is maintained, but it is clearly working against the overall health of the organism[119].

There can even be a sort of social-behavioral pathological homeostasis in situations where individuals are led to perpetuate certain habits even at the expense of health. This could be seen in what are called double-bind situations, e.g. when someone is punished for a certain behavior and then punished for learning to avoid that behavior, leading to a situation where the victim sees every reaction as leading to punishment (Visser 2003). Once this 'homeostasis' is established, it tends to be self-perpetuating: the victim tries to avoid punishment and is punished for doing so. As there is no chance to provide a meta-discussion of the situation, it often only improves when the whole relationship dynamic is changed. It is even claimed that schizophrenia can emerge as an individual's way of coping with such situations (Gibney 2006). In all of these examples, a form of homeostasis is maintained despite the pathological effects on the individual organism, making appeals to homeostasis insufficient to conceptualize health.

A second problem for homeostasis is in dealing with the body's anticipatory responses, which now fall under the heading of 'allostasis' or achieving physiological viability through change (McEwen & Wingfield 2003; Schulkin 2004). Here the claim is that bodily mechanisms are not primarily concerned with maintaining stability (homeostasis), but with adapting to and even anticipating changes[120]: 'Homeostatic regulation is too passive a notion for the resources required to maintain long-term viability and reproductive success' (Schulkin 2011, p. 2). Furthermore, homeostasis 'is about maintaining the same conditions; allostasis emphasizes change. Change is the core feature of evolution and successful adaptation' (Schulkin 2011, p. 2). One result of this is that homeostasis-based accounts might struggle to conceptualize physiological and behavioral flexibility, which are more about adaptive responses than maintaining norms[121]. Behavior, such as obtaining food, is indeed a method for regulating bodily metabolism (Ananth 2008, p. 191), but the viability of such behavior is in its ability to adapt to changing demands.

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[119] A recent study claims that a similar pathological preservation appears in how dopamine is regulated in the development of Parkinson's disease (Leviel et al. 2012).

[120] A quick glance into the history of the concept of homeostasis shows that it has always struggled to deal with such adaptability. This is witnessed in the various concepts that have been proposed to capture this phenomenon over the years from 'predictive homeostasis' and 'rheostasis' to 'homeorhesis' (Schulkin 2011, p. 2).

[121] Also, the ability to change in terms of plasticity seems to be what generates homeostatic processes (Woods 2009), which could imply that equating health and homeostasis misses how being healthy also involves the ability to establish new norms.

Another way of formulating this problem is by arguing that the variability of bodily parameters is more fundamental for understanding health and survival than the constancy of essential functions (Sterling 2004). In this view, the values of essential functions are not 'normal' because statistically common, but common because they reflect shifting demands. In other words, they are normal not because they are frequent but frequent because they are viable under given conditions (Canguilhem 1989, p. 160). While these regulatory capacities were likely selected insofar as their ability to function within a given range aided survival in past environments, the point is that it is their variability, rather than their average value, that explains how shifting demands are met. 'This is true for all states and all parameters: average values are useless. *The essential need is to occupy distinctly different states and move flexibly between them*' (Sterling 2004, p. 25; emphasis added). Moreover, prolonged deviations from 'normal' homeostatic conditions could be considered an 'error' or dysfunction in relation to an etiological account, whereas when considered in terms of allostasis they could signal a new functional norm. A failure to understand this can be clinically problematic or even iatrogenic if the treatment aims to return the body to previous conditions, rather than addressing the new norm (Sterling 2004), e.g. telling insulin resistant individuals to eat less and exercise more.

An obvious retort is that in each of these examples there is some evolved homeostatic mechanism or propensity that was initially disrupted, or that those mechanisms maintaining the pathology, such as bodyweight in the case of obesity, can be distinguished from some higher level of homeostasis, and so the homeostatic concept of disease still does some explanatory work. However, these are not examples wherein one level of homeostasis is disrupted so as to maintain another level (such as with fevers or allergic reactions, which can involve positive feedback which is *not* homeostatic). Rather, such examples point to the problem that, either at the cellular or organismic level, homeostasis does not *necessarily* tend to maintain or achieve health, but merely *tends to preserve a state of stability, even, in certain cases, at the possible expense of health.* In the cases of pathological homeostasis, the body's homeostatic mechanisms are still functioning 'normally and naturally' (i.e. as they were selected to function), and yet they are pathological by trying to maintain the present norm. What seems to constitute the pathology in these examples, then, would only be partly explained by homeostatic disruption, suggesting that something more is involved. This is not to argue that homeostasis is useless for understanding these issues, but rather that homeostasis (or its disruption) would only be one factor which contributes to the health (or disease) of an organism. A better approach, then,

needs to account not only for regulatory physiology, but also for adaptive physiology (Schulkin 2003), i.e. the role of organism-level responses to novel conditions. Such an approach will be explored in the next chapter.

While all three Darwinian or evolutionary approaches provoke new questions and problems, they seem to share the following aspects in common. First, disease is best understood as some form of deviation from or disruption of naturally selected functions. While Wakefield's account brings in the issue of social values, his etiological approach is still open to many problems. Second, the standard for determining such a deviation in humans is primarily the biological design that was shaped in our ancestral environment. What we now consider to be normal 'was shaped during the geological era known as the Pleistocene, so that any deviation from this prior evolutionary state ultimately results in disease, pathology, or abnormality' (Méthot forthcoming, p. 20). While saying that 'any' deviation constitutes disease is surely an overstatement, the idea that our ability to determine what is now normal or pathological largely depends on referring to ancestral conditions seems to be a crucial component of these etiological approaches.

3. Conclusion

Ultimately, a generalized vulnerability to disease, as is suggested by Darwinian medicine, might provide an evolutionary explanation for *why* we get sick, but some empirical and philosophical limitations to these approaches suggest that they are insufficient to adequately explain the environment-dependent nature of biological and medical norms. As I have been arguing throughout this dissertation, it is precisely this dependency that helps to distinguish the normal from the pathological. In a rather strong formulation of this problem, Marc Ereshefsky claims that 'there are no norms in evolutionary biology and the norms of physiology are not evolutionary' (2009, p. 225). What he seems to mean is that the plasticity/variability of individual organisms will perpetually 'haunt' an evolutionary approach to health and disease by challenging what we take to be 'normal and natural'. It is because it is 'natural' for a given genotype to produce a range of phenotypes depending on contingent environmental circumstances that 'normality' has no absolute meaning (Sober 1980). As physiological norms appear to be rather context-dependent, this would provide support for the ecological account defended in this dissertation. Moreover, as individual organisms can adapt to

changing circumstances throughout their lifetimes (as I will discuss in the next chapter), this only further complicates the ability to ground medical judgments on past evolutionary norms.

One might even argue that the guiding thread of medicine is to understand the individual organism in its totality, i.e., incorporating its singular genetic and epigenetic composition, developmental and life history, social and behavioral norms (e.g. diet, physical activity, work), ecological factors, etc. (Childs et al. 2005). As such, any reference to past evolutionary norms might clarify disease etiology, but will be insufficient to clarify disease ontology without an adequate focus on the unique concatenation of events that constitute the present dynamic organism-environment relation. In other words, the historicizing of health and disease that is suggested by a Darwinian approach is not necessarily incorrect, but needs to be taken further to account for this biological individuality. One of Canguilhem's main insights is that it is because organismic norms can vary relative to changing environments that the problem of individuality is inescapable for medicine. While plasticity and other forms of variability seem to challenge the 'foundational' status of evolutionary theory for health and disease, could such properties in themselves serve to clarify these concepts? Could an 'updated' version of Canguilhem's theses help to show both what is at stake when trying to define health and disease and better capture the 'science of the individual'?

Chapter Six

Health and Disease In Vivo: On Surnaturalism, Robustness, and Flexibility

> I mean by *plastic power* the capacity to develop out of oneself in one's own way, to transform and incorporate into oneself what is past and foreign, to heal wounds, to replace what has been lost, to recreate broken molds.
>
> Friedrich Nietzsche, *Untimely Meditations*

> Liberty is the possibility of being, not the obligation to be.
>
> René Magritte

In this chapter I would like to tie together some of the various strands of the argument that have been unfolding throughout this dissertation. In chapter 1, I suggested that Canguilhem provides a different approach to conceptualizing health and disease than is typically found in conceptual analyses. Rather than beginning with an aim to clarify and guide medical judgment, he provides some characteristics of health and disease as involving distinct processes peculiar to living beings. In this sense, he offers a possible way to *naturalize* these concepts (Lemoine 2013). In chapters 2 and 3, I showed how his ecological account of biological norms implies environmental and organismic relativity. Canguilhem's 'holism' implies that as organisms exhibit systemic self-organizing properties whose functionality is determined relative to changing environmental demands, whether organisms are healthy or not depends on their capacities in their environment. In chapter 4, I suggested that Canguilhem's account of biological normativity is quite similar to the concepts of plasticity and evolvability, and I left the question open as to whether the concept of plasticity could help to rethink health and disease. In the previous chapter, I showed how evolutionary accounts also aim to incorporate environmental considerations, but seem to run into considerable problems when doing so and thus prevent a cogent conceptualization of health and disease. Thus, if we are to develop a plausible approach that naturalizes these concepts by appealing to biological properties, how could this be done?

I will first bring together the insights from chapters 2 and 4 to reframe Canguilhem's ecological approach in terms of contextualism and I will clarify his peculiar naturalistic understanding of health and disease. This will help to show how his account can address some conceptual problems. I will then use Canguilhem's conceptual framework to construct a new

definition of health and disease based on the biological properties of phenotypic flexibility and robustness. I will first describe what these properties are and sketch their medical relevance. From there I will develop the new definitions and consider two ways in which they could be operationalized. I will conclude by mentioning some of the benefits of this approach and how it might clarify the complex relation between evolutionary biology and medical norms. While defining health and disease relative to environments seems promising, the next and final chapter will explore some of its potentially controversial consequences when it comes to understanding the complex role of social norms for human health.

1. Reframing Canguilhem's Approach via Contextualism and Surnaturalism

As I showed in chapter 4, Canguilhem's concept of biological normativity seems quite relevant to contemporary issues in philosophy of biology in that it captures the same basic idea as expressed in phenotypic plasticity. The idea that organisms are fundamentally responsive, or non-indifferent, to their conditions of life, as is demonstrated by plasticity, permeates Canguilhem's philosophy. This is reflected in how a given genotype can produce a range of phenotypes in different environments and how organisms are capable of adjusting their morphology and behavior throughout their development and even later in life in response to changing demands. It is the responsiveness of organisms that allows for new norms to be established, that allows for their normativity. It is because Canguilhem begins with such biological properties that he can then argue that organisms and environments are inseparable.

As both Canguilhem and recent theories of niche construction suggest, organisms are not only shaped by their surroundings but also create and structure their environment according to their needs and activities. Through this milieu construction, organismic behaviors (from unicellular organisms enveloping foods and excreting waste, to plants altering soil chemistry, to human technology and culture) become value-laden or even 'hedonic' (1989, p. 127) in that they express the organism's non-indifference towards its environment. Again, it is this non-indifference that produces a variety of norms in living beings. Consequently, biological norms are always relative to the non-indifferent activities of the organism in its environment. Two important philosophical consequences can be drawn from these claims.

First, as I showed in chapter 2, there is no absolute meaning to 'normality' because of this environmental relativity, and this relativity helps to distinguish anomalies from

abnormalities. This distinction ultimately turns on *whether the anomaly affects the viability of the organism in its environment*. For example, given the right conditions, a mutation leading to a wingless insect could be beneficial, whereas in other environments such a mutation might not survive (Canguilhem 1989, p. 142). This is often a problem that plagues biostatistical approaches since an extreme variation, such as a genetic mutation, that produces a viable phenotype will have to be labeled both healthy insofar as it is viable and pathological insofar as it is a significant deviation from the species type. While evolutionary approaches (e.g. Wakefield 2001) suggest that such mutations are simply lucky accidents (until they will have been selected for) despite their beneficial effects, this seems to miss something biologically important. What makes normality a relative concept is that traits are not normal because selected, but they are selected because of the effects they have on an individual organism in its current environment. In Canguilhem's terms, they are selected because normative. Contrary to etiological approaches, Canguilhem's view suggests that mutations that produce novel functions should be considered functional based on their effects on the organism, regardless of their rarity or novelty[122]. It makes little difference whether the mutation is an accident (Wouters 2005). If the mutation aids the organism's ability to maintain its organization and respond to changes in its environment then it seems more accurate to claim that it is functional in that environment.

Secondly, Canguilhem claims that normality is not only relative to an environment, but also to individual organisms: 'from one individual to the next the relativity of the normal is the rule' (2008, p. 130). While this appears to challenge the very distinction between health and disease, what is at stake is arguing that while the distinction can be unclear between individuals, it is more certain for the same individual. This individual relativity can be seen both between and within individuals. For example, in some individuals hypoglycemia poses little to no problem, whereas in others such low blood sugar levels could be fatal (1989, p. 171). Some individuals have genetic mutations such that consuming various foods, such as those with lactose, gluten, or some proteins found in legumes (e.g. lectins), can produce serious allergic reactions, whereas in others with the same mutation there can be no problem or even a possible benefit depending on their environment (1989, p. 282). This individual context implies that the individual organism provides its own norms relative to changing conditions or demands (2008,

[122] As Wouters (2005) points out, etiological accounts deny that parts of so-called 'instant organisms' can have functions because they have no selection history. However, this is problematic since it runs contrary to functional accounts in much of biology.

p. 129). It is thus relative to the individual organism in its environment that the transition from normality to pathology becomes clearer: 'It is the individual who is the judge of this transformation because it is he who suffers from it from the very moment he feels inferior to the tasks which the new situation imposes on him' (1989, p. 182). Moreover, this individual context implies that demands and capacities change throughout an individual's lifetime, in part because one's behaviors and environments change, and also simply because aging entails new physiological norms. The same hypertensive individual could be normal in one environment (e.g. low altitude), while pathological in another (e.g. high altitude). While what is normal for an older individual would often be considered a deficiency for a young adult (1989, p. 284), this does not entail that one should compare current norms with previous ones in terms of life history, such that the incapacities associated with aging would themselves become pathologized in relation to previous norms. Rather, this is simply to stress how normality alters as a function of one's life history: 'This recognition of the individual and chronological relativity of norms is not skepticism before multiplicity but tolerance of variety' (1989, p. 284).

Together, these two aspects constitute what could be called Canguilhem's 'contextualism', to borrow a concept from the philosopher of medicine Lawrie Reznek (1987, pp. 168-170). Contextualism is the view that truth conditions can be applied differently depending on the context in which a sentence is used because the terms are relational, as is the case with 'disease'. Consequently, we

> cannot decide whether a judgment about disease-status is true without considering the relation of the condition to the organism, and the relation of the organism to the environment. One organism's disease is another's adaptation, as is one environment's disease another's adaptation (1987, p. 169).

Since the conditions for determining the truth of a proposition are relative to an environment, the same trait could have pathological effects in one environment but not in another. A contextualist approach is supported by the above claims regarding the responsiveness and plasticity of organisms: the very existence and viability of biological norms are inseparable from the context in which they occur. In other words, it is because organisms can be normative or plastic, adapting to changing demands, that normality and pathology are relative to environments and individual organisms.

There are at least two important differences between Reznek's approach and Canguilhem's. The first is that Reznek sees 'harm' or being worse off as inescapable for

understanding disease, thus supporting the normativist view that disease is inherently value-laden (1987, p. 153). While 'harm' and value do play some role in Canguilhem's account of disease (e.g. the '[p]athological implies *pathos*', (1989, p. 137)), he actually allows for a way to *naturalize* value. In other words, if we accept the claim that organisms are responsive to their conditions of life, then biological norms are already an expression of value, with disease being negatively valued[123] as a restriction on or reduction of the organism's ability to maintain itself amidst changing demands. This also reflects the 'hedonic' character of biological norms: the negative valuation of disease is seen in how organisms respond to infections, lesions, mutations or pain through altered functioning, self-repair or self-medicating behavior. Human values, while often more complex, are an extension of this biological non-indifference. Secondly, an issue arises when we consider the human social environment. While this will be discussed in more depth in the next chapter, I will point out for now that if normality is relative to an organism's environment (Reznek 1987, p. 87), and if the human environment is thoroughly constituted by social norms such that conforming to them is adaptive, then should this not influence our concepts? Why would homosexuals living in a social environment that causes them harm be different than a dyslexic in a literate environment or an extremely tall pygmy (Reznek 1987, p. 85)? Reznek claims that while we would be better off without homophobic prejudice, one is not harmed simply by being homosexual and consequently homosexuality is not a disease. While I agree regarding the issue of homophobic prejudice, it is possible that this issue is more complex than Reznek suggests, especially when we take the experience of being homosexual in certain environments into consideration. For now, the concept of contextualism seems to be a useful way to think about Canguilhem's thoughts on normativity. How does this help to clarify the concepts of health and disease?

While he does not provide one fixed definition, and despite some variation throughout his writings, the following examples can be used to capture the core of Canguilhem's position. Health, he argues, can be defined as 'a margin of tolerance for the inconstancies of the environment' (1989, p. 197). More completely, health is characterized by 'the possibility of transcending the norm, which defines the momentary normal, the possibility of tolerating infractions of the habitual norm and instituting new norms in new situations' (1989, p. 196f). In

[123] This does not necessarily mean that health and disease are a matter of what the individual thinks, since clearly one can have a problem without knowing it. Rather, it means that these phenomena are relative to the dynamic relation between *individual activities* and the environment. Valuation is thus a matter of behavior, not representation.

this view, then, there are two sides to health which will be further explored in the next two sections: the capacity to *tolerate variations* within what is typical for that organism and also *being able to adapt* and establish new physiological or behavioral patterns/norms (transcending old ones) to meet changing demands (2008, p. 132). It is this latter aspect that shows there to be an intimate relation between health and normativity. Organisms are healthy insofar as they are normative relative to environmental fluctuations (1989, p. 228). The behavior and functioning of healthy organisms thus entails the capacity for persistent or maintained adaptability.

Conversely, disease is 'a reduction in the margin of tolerance for the environment's inconstancies' (1989, p. 199), involving constricted physiological or behavioral patterns/norms (1989, p. 222). In relation to the two aspects mentioned with health, disease entails a qualitatively reduced capacity for tolerating variations and for adapting to changing demands: the narrowing of normativity. Disease can also be understood as involving a threshold effect whereby a quantitative variation produces qualitatively new physiological or behavioral patterns. Some examples that Canguilhem gives are how diabetes alters not only the kidneys but the endocrine system as well as the organism's overall behaviors, the effects of hypertension on various vital organs, systemic immune reactions to infections, and the behavioral effects of neurological damage[124] (1989, pp. 80-86). For each disease there is likely to be a unique threshold determining which variations result in a qualitative change, a 'new dimension of life', for the organism as a whole (1989, p. 186). As this transition can entail more or less of a reduction of the organism's 'innovation possibilities' (1989, p. 196), there are various degrees to which one can be diseased.

Following from this view, Canguilhem claims that health and disease are properties of the 'whole' organism, not its parts, since 'in the living organism all functions are interdependent and their rhythms are coordinated' (1989, p. 84). While medicine has to localize in order to provide treatment, he stresses that we should not allow this therapeutic necessity to negate the integrated and dynamic structure of organisms. Similar to the property of 'life' (Nicholson forthcoming), health and disease are not to be found in the separate parts or matter comprising organisms, but in their total *organization*. This implies, then, that health and disease are defined based on organizational and physiological capacities: the organization allows for variations to be tolerated and physiology involves adjusting to changing demands. This

[124] Some other examples of threshold effects can be found in genetic mutations in mitochondria (Rossignol et al. 2003), serum cholesterol levels (Goldbourt et al. 1985), brain development in hypothyroidism (Tillotson et al. 1994), and brain lesions (Boone et al. 1992).

explains why not every deviation, be it morphological or functional, is pathological, but can become pathological when it reduces the organism's capacities to meet the demands of its milieu. Both health and disease, then, should be understood in relation to the nature of the organism as a complex self-organizing network of interrelated processes whose value is determined in relation to the internal and external milieu.

An interesting way of conceptualizing how this view differs from the standard naturalist account whereby health is value-free 'normal' (evolved) functioning could be to see it in light of Canguilhem's interest in surrealism[125]. Similarly to how some surrealists sought to challenge certain views of reality by appealing to the transgressions of dreams and the role of the imagination for opening up new possibilities that go beyond what is currently real, Canguilhem's view could be called surnaturalist as it challenges what we take to be 'normal and natural' by acknowledging the plasticity and variability of life. Biological normativity implies that biological norms are characterized not by how they conform to what they ought to be, but by how they show what organisms are capable of being[126]. In other words, it is because of this normativity that 'adaptability depends on variability' (1989, p. 268): to survive entails the ability to adapt to environmental conditions, either for individual organisms or for a species as it evolves. If an organism is only capable of living in a very stable or restricted environment, it is still viable and thus normal in that environment. It is only when new demands arise that it shows itself to be healthy or not, that it reveals its capabilities.

Referring to an excerpt from the surrealist poet Antonin Artaud, Canguilhem describes health as 'the capacity to surpass initial capacities, a capacity to make the body do what initially seemed beyond its means' (2012, p. 49). To be healthy is thus to be 'more than normal' (1989, p. 200; 2008, p. 132), as it involves the assurance to take risks and test one's capacities[127]. This

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[125] This is suggested by Canguilhem's evocation of surrealism when discussing the role of the imagination in the concept of monstrosity (2008, p. 143), his reference to the surrealist poet and playwright Antonin Artaud in *Writings on Medicine* (2012, p. 49), or his knowledge of the work of French social theorist Roger Caillois whom he cites in *Knowledge of Life* (2008, p. 186). In *The Normal and the Pathological*, Canguilhem also cites a 1957 essay by François Dagognet entitled 'Surréalisme thérapeutique et formation des concepts médicaux' which was dedicated to Gaston Bachelard whose work on the imagination was quite influential for Canguilhem and whose ideas were close to those of the surrealists. Finally, Dagognet also describes Canguilhem's work as 'vitalisme surrationnel' (2007, p. 24), explicitly referring to the surrealist focus on how art can transgress conventions and rules.

[126] In some unpublished notes on 'Norme et normal en biologie' (n.d.b) from 1962-63, he writes: 'le normal c'est non ce qui doit être, mais ce qui peut être. Mais ce qui peut être ici c'est ce qui peut vivre. La propre de la vie c'est de varier les façons de vivre (structures et comportements), de tenter la composition de toutes sortes de moyens pour occuper les places vacantes' (p. 42).

[127] He even suggests that the fact that organisms have more parts than needed allows for risks to be taken, for variations to be tolerated (Canguilhem 1989, p. 200). This is the same idea captured by the concept of 'robustness',

implies that being able to abuse one's health and the threat of disease are part of healthy functioning. For surnaturalism, disease has its own norms; it is normal 'under certain conditions and in its own way' (1994, p. 351). To be diseased is not to lack a norm, but to live according to a new reduced norm. Thus, disease entails a reduction in what one is capable of doing, whereas health involves going beyond previous capacities. Anyone who has been sick or injured has surely experienced the dynamic of how the restrictive norm of disease gives way to the expansive norm of health as one convalesces.

This view is surnaturalist by showing how, in one sense, as life continually creates novelties anything can be 'normal' insofar as it is viable in its environment, and in another sense normality is not a matter of stable essences or regularities, but is better understood in terms of 'equilibrium and adaptability' in an environment with changing demands (1989, p. 269). What is 'normal and natural' is not to conform, but to transgress the temporary norm. If there is a qualitative difference between health as being more than normal and disease as involving its own narrowed norms or regularities, then this suggests that they should be understood as involving distinct biological processes. Health is thus not merely the absence of disease, and disease is not simply the opposite of 'normality'. Saying that health is being 'more than normal' is to suggest, then, that the organism maintains its structure by flexibly adapting to changing demands, by 'taking risks'. With such a view, health is not determined relative to unknown or hypothetical future demands, but is determined based on whether the organism actually surpasses previous capabilities so as to maintain itself amidst a given set of demands.

While this reframing of Canguilhem's view in terms of contextualism and surnaturalism suggests an interesting way to understand his ideas, it also opens the door to some problems. For example, one problem is that of distinguishing between failures to adapt and failed adaptations. According to an etiological account, while drowning in the ocean or freezing and suffocating when exposed to lunar conditions might certainly be instances in which an organism fails to meet environmental demands, they need not be considered diseases precisely because there is no malfunction involved. In other words, if humans have not evolved an ability to carry out some behavior in certain environments, then the inability to do this behavior need not be the sign of a dysfunction or disease.

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which I will explain shortly. The idea of how disease is characterized by a lack of risk-taking, being incapable of carrying out normal tasks, can also be seen in Freud's account of melancholia (1917).

Such intuitive examples appear to challenge Canguilhem's account, but they also seem to harbor a misunderstanding about biological norms that Canguilhem's contextualism helps to clarify. On the one hand, organisms are viable not merely because they are selected, but they are selected because viable under given conditions (and if those conditions persist, then they are likely to remain viable). On the other hand, organisms are not selected because they live in 'normal' environments, but rather an environment becomes normal because organisms are viable in it (1988a, p. 120). Organism and environment are inseparable. If it is the relation between an organism and its environment that determines whether the organism is normal or not, then it actually seems biologically accurate to claim that failures to adapt or to tolerate environmental conditions are indeed pathological.

This could be understood in the following way. First, without having to appeal to past selection history it is clear that in certain environments an organism would function in a rather restricted way, e.g. the gasping for air and rapid slowing of cellular and metabolic activity that a human would experience on the moon. It is this restriction that is the variation from the organism's norms that would be experienced as pathological (and hence is 'negatively valued'). The point is that it is not the *inability* to adapt to those conditions that is the disease, but that the diseased condition *results from* the inability to adapt. Of course, it can be argued that the organism would have been healthier if it were able to adapt, and compared to other organisms that are able to adapt to such conditions, its norms have a narrower range of adaptability. This comparison does not imply, however, that this narrower range is in itself pathological, but simply that it requires a different range in order to be healthy. This is also what Kingma's (2010) description of 'situation-specific diseases', or diseases caused by some situational factor, seems to point out. It is the disruption of the organism's ability to meet environmental demands that constitutes the pathological character of such diseases.

With another example, such as albinism, it is uncontroversial that a sunny environment could be adverse for such individuals by causing skin damage[128]. A contextualist would claim, however, that in an environment with very little sun it need not pose a problem and could even become advantageous (Reznek 1987, p. 86). While abnormal in some environments, it could be simply an anomaly in others. Of course, there are many degrees and types of albinism, with some being coupled with various visual defects. The point is, amidst these variations in

[128] One could also point to the harmful effects of being an albino in social environments where their severed body parts are highly valued due to superstitious beliefs (Maron 2013).

albinism only some of them are pathological insofar as they disrupt the organism's physiological and behavioral capacities in its environment. The point at which the anomaly shades into an abnormality thus depends on this organism-environment relation.

In some sense, then, it is intuitive to claim that if we have never evolved to tolerate certain demands, such as living on the moon, then our inability to perform them should not be considered a dysfunction. However, an ecological or contextualist view might force us to rethink these intuitions. If health and disease are properties affecting the relation between organisms and their environments, then an inability to meet the environment's 'inconstancies' can result in a pathological condition in a given environment, regardless of the rarity of that environment. Furthermore, while the fact that humans have not evolved to live under certain conditions might support the claim that our inability to do so is not dysfunctional, this could also be challenged if we go 'beyond the body' to include technology and the human capacity for niche construction[129]. The point here is not that we have a disease simply because we are incapable of meeting certain hypothetical demands, but that this incapacity becomes pathological *under those conditions*. As health and disease are relative terms, and are also a matter of degree, they are not determined simply based on objective conditions (e.g. conformation to/deviation from evolved norms), but on the actual organism in its environment.

The following questions still remain. In what way can this ecological or contextualist position be upheld today? In other words, while environmental relativity is less controversial, is this individual contextualism biologically coherent? In the next two sections, I will attempt to show that by fleshing out some of Canguilhem's ideas in relation to more recent research in developmental and ecological biology we can arrive at an interesting formulation of health and disease that might avoid some of the conceptual and empirical problems plaguing naturalistic accounts.

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[129] This could suggest the odd claim that when a technological advancement or treatment appears, then something stops being a disease. It seems as though this could be defended if the advancement implies that the pathological effects of the dysfunction are mitigated or managed, thereby allowing for a new norm to be established. Again, if health and disease come in degrees, then someone surviving thanks to medications could be said to have a precarious level of health, since their new norm is only tenuously maintained. Underlying conditions can therefore be managed without manifesting themselves as full-blown diseases. This also touches on the issue of disability. For example, glasses and wheelchairs are not mere prosthetics, but change the way the human organism relates to its environment. This does not mean that visual and motor defects are not potentially problematic, but that whether they are problematic depends on how they affect the organism's relation to its environment, which is also a function of tools and technology. In an environment without wheelchairs, abasia will likely be pathological, whereas in our modern environment, they can produce different norms of motility. For an interesting take on how Canguilhem's ideas relate to the issues of tools and cyborgs, see Hacking (1998a).

2. Bringing Robustness and Flexibility into Medicine

The arguments from Canguilhem imply that if we are going to better describe healthy and pathological norms, then we must do so at the level of the organism. In other words, we need to incorporate the organism's organizational and physiological norms, since it is relative to how the organism as a whole (organization) is adapting to changing demands (physiology) that health and disease are determined. In this section, I will discuss the properties of phenotypic flexibility (a kind of phenotypic plasticity) and biological robustness and suggest that by using them to develop Canguilhem's contextualism we can construct a more biologically coherent account of health and disease. It should be noted from the start, however, that since these are properties of biological systems that can be found at various levels, it is important not to immediately graft health and disease onto them because, as I have argued, health and disease are best understood as properties of 'whole' organisms. Moreover, as we will see, plasticity and robustness can also be sources of disease leading us into a similar conceptual problem as we saw with 'pathological homeostasis'. In order to establish the potential medical relevance of phenotypic flexibility and robustness, then, I will describe these phenomena with an aim to show what they mean for the organism as a whole as it is faced with changing environmental demands during its life history.

As a result of the polyvalence of the concept of plasticity mentioned in chapter 4, I will take a broad approach to plasticity as a property of developing and mature living systems whereby different phenotypes arise in relation to changing environments. This approach remains agnostic regarding whether plasticity is primarily morphological or a property of genotypes (Nicoglou 2011). This capacity for variability can be found on various levels of biological organization: from the genetic, molecular, and cellular, to the developmental, physiological, metabolic, and even with behavior and learning[130]. What is interesting to stress is that plasticity is not only a property of traits and genotypes, but even of whole organisms, in that it can involve systemic responses, such as physiological accommodations to mutations or lesions (West-Eberhard 2005b), as well as behavioral adjustments. Plasticity also spans across biological taxa, being a seemingly ubiquitous biological property (Pigliucci 2005; Bateson & Gluckman 2011):

[130] For all of these and more see Newman et al. (2009), Pigliucci (2001), and Bateson & Gluckman (2011).

> Phenotypic plasticity should probably be considered the default state of organic systems (whole organisms or their composites), because of the inherent physical-chemical properties of biomolecules, which tend to alter their properties when some aspects of their environment change (Pigliucci 2001, p. 214).

There is one type of plasticity, termed physiological plasticity by some (Pigliucci 2001) or phenotypic flexibility by others (Piersma & Lindström 1997; Piersma & Drent 2003), which is relevant for understanding organismic adaptability and by extension health and disease. Phenotypic flexibility refers to the physiological variability that occurs within an organism's lifetime and which is 'reversible' or temporary. The reason Piersma et al. prefer a separate term is to distinguish it from other kinds of plasticity which refer to variations within a population that are irreversible, e.g. developmental plasticity or polyphenism, whereby the plasticity reflects various pathways taken in response to early environmental triggers but which are either difficult or impossible to undo. Examples of flexibility can be seen in how some animals alter their organ size, body size, and even their sex depending on the time and demands of the life cycle, as well as changing food conditions (Piersma & Lindström 1997; Piersma & Drent 2003). Such flexibility is also seen in plants, e.g. when leaf types in aquatic plants vary (heterophylly) in relation to changes in water level and seasonal patterns (Wells & Pigliucci 2000), as well as in bacteria, e.g. when flagella are used to propel bacteria towards or away from varying chemical concentrations, the ability to switch between metabolic capacities (Meyers & Bull 2002), or in the physiological and metabolic capacities of microbial biofilms (Costerton et al. 1995; Smits et al. 2006). Similar to what is captured by the concept of 'allostasis', flexibility entails that the so-called bodily 'constants' can fluctuate depending on changing demands, e.g. variations in thermoregulation and basal metabolic rates (Piersma & van Gils 2011). If we can define the organism along the lines suggested by Pradeu (2010), then the kinds of systemic immune reactions he describes would also be good examples of organismic flexibility.

Two aspects should be retained regarding flexibility. First, it is a *physiological* or functional property, i.e. it describes the changes that organisms make in terms of morphology, functions, or behavior that allow them to meet changing demands. Second, many of these examples of flexibility pertain to the organism as a 'whole' (Bateson & Gluckman 2011, p. 32). In other words, flexibility can be an 'organismic adaptation, at the level of the individual' (Piersma & Lindström 1997, p. 137) whereby morphological and physiological changes are coupled with behavioral changes or vice versa. Flexibility is thus a property that can be found

throughout biological taxa and which can entail the systemic regulation of the organism as a whole. Such whole-organism capacities bring us closer to medical concerns since it is, after all, the whole organism, within its lifetime, which will become healthy or diseased.

Now that I have established the nature of flexibility, it is important to see how it relates to another fundamental property of living systems: biological robustness. This concept does not quite have the historical and conceptual difficulties that we saw with plasticity. It is, however, closely linked with the developmental concept of 'canalization' (Waddington 1942; Jablonka & Lamb 2004) whereby various traits of a developing organism become increasingly fixed or 'canalized' over time such that their development tends to withstand perturbations. It is from within this historical tradition that robustness has been generally defined as the *organizational* property of biological systems that allows them to maintain their functions or performance despite internal or external perturbations[131] (Kitano 2007a). Like flexibility, robustness is also a property that can be found on various levels of biological organization: from the molecular and genetic, to the cellular, physiological and immunological (Stelling et al. 2004; Kitano & Oda 2006). Robustness, then, seems to be inherent to living systems and is ubiquitous throughout nature: from RNA viruses and bacteria to plants and animals (de Visser 2003; Elena et al. 2006; Freilich et al. 2010; Lempe et al. 2013). One interesting conceptual distinction to point out is that this property can be distinguished from homeostasis since the latter describes the ability to maintain a given *state* or set-point, e.g. maintaining body temperature or nutrient levels, whereas the former describes the maintenance of *functions* even when the system has to change, e.g. in plastic or allostatic responses[132]. If the function is that which maintains the state or stability of a system then the two can overlap, but otherwise they refer to distinct properties.

There are two important aspects of robustness to be retained. First, robustness refers to how biological systems are *organized* such that their functionality can be maintained. A robust biological system is one whose peculiar organization is capable of tolerating perturbations. Second, as this organizational property is systemic, it can even refer to the organism as a whole (Kitano 2004). Since we can argue that the organism as a whole is characterized by this organizational property of tolerating perturbations, we come closer to the concepts of health and disease.

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[131] As such, robustness is not the process of canalization, but its result: the property of having canalized traits is robustness.

[132] As Kitano writes, 'Whereas homeostasis and stability are somewhat related concepts, robustness is a more general concept according to which a system is robust as long as it maintains functionality, even if it transits through a new steady state or if instability actually helps the system to cope with perturbations' (2007a, p. 1).

Going further, while robustness could be seen as opposed to plasticity, with the former bringing out a system's sturdiness and the latter its malleability, what is interesting is that when dealing with complex biological systems these properties seem to reinforce one another, as when 'plasticity enables organisms to robustly adapt to a changing environment' (Kitano 2004, p. 828). Moreover, not only does plasticity generate robustness, but plasticity is also regulated by robust systems (Bateson & Gluckman 2011, p. 46). Understanding organisms as adaptive systems entails that 'operating far-from-equilibrium forces them to explore their spaces of possibility – to tinker with new patterns of acting, to modify internal relations, and so on. Such explorations help them evolve new structures and ways of working' (Davis & Sumara 2010, p. 45). Being characterized by their responsiveness to environmental conditions, organisms maintain their robustness amidst perturbations by being capable of flexible responses. Together, plasticity (or flexibility, more specifically) and robustness illustrate two adaptive properties of living beings: the one physiological, the other organizational. Flexibility and robustness, then, are interdependent biological properties that can be described on the level of the whole organism and which reflect the changing demands of the environment in which the organism lives. They provide a more coherent way of understanding how individual organisms can not only maintain their various functions amidst changes (e.g. maintaining homeostasis), but can also alter their morphology, physiology, and behavior to better adapt to changing demands or even alter the environment to make their unique physiology more viable.

I would now like to demonstrate the medical relevance of these properties by looking at several ways in which they can be used to understand pathogenesis. The restriction on an organism's norms can arise in many ways, pertaining to either robustness or flexibility, depending on the kind of pathophysiological restriction involved. First, disease can arise precisely because the production of robust systems creates fragilities such that as robustness increases so does fragility: 'it is not possible to simply increase general robustness of the system without a sacrifice in performance and increased resource demands' (Kitano 2004, p. 833). As such, pathology can arise due to a disruption of the ability to tolerate certain types of variations, whether they are due to an inadequate metabolic situation, a microbial infection, a genetic mutation, or an environmental change. For example, while the immune system is robust against certain perturbations it is also fragile to autoimmune responses triggered by pathogens or perturbations in commensal bacteria which undermine the host's defenses (Kitano & Oda 2006). Secondly, there is the interesting finding that pathologies can result from

robustness itself. In other words, some diseases entail a 'hijacking' of robustness whereby robustness is 'used' such that the pathological condition is maintained, as when a cancer tumor's genetic diversity and interactions between it and the host ensure that the cellular regulation in the cancer is robust, allowing it to grow despite therapeutic interventions (Kitano 2007b). Diabetes and overall metabolic syndrome also provide interesting examples of where there is an initial disruption of robust mechanisms for regulating glucose followed by a hijacking of robustness as the pathology progresses. Diabetes involves an altered robustness whereby hyperglycemia and hyperinsulinemia are maintained as the norm, coupled with a reduced metabolic flexibility (Mobbs et al. 2007).

These examples show why robustness, like homeostasis, is not in itself a sign of health without a reference to the organismic capacity to adapt and create new norms (flexibility). Similar to the case of pathological homeostasis, what constitutes the pathology of pathological robustness (e.g. cancerous growths or hyperglycemia in metabolic syndrome) is that the individual's ability to adjust to these new demands, i.e. its flexibility, becomes constrained by the presence of the pathological variation. As pathological robustness restricts flexibility, there is a shift from physiology to pathophysiology, and as such we begin to see how pathogenesis can be understood in terms of its effects on flexibility.

Pathogenesis can also occur due to the nature of plastic systems. For example, the developmental origin of health and disease theory suggests that while being developmentally plastic can allow for adaptive changes to occur so as to avoid certain threats, this can be detrimental for the organism later in life due to insufficient or even reduced resources for other activities, or when environmental changes become rather unpredictable (Hanson & Gluckman 2008; Gluckman et al. 2009; Feinberg & Irizarry 2010; Gilbert & Epel 2009). With flexibility, behaviors which aim to predict various conditions can be inaccurate and might not adequately track environmental changes, leading to increased disease susceptibility. This can also become problematic when the environment chronically elicits such flexible responses of the organism which, due to their high energy requirements, can diminish the robustness of other systems, such as the immune system (Schulkin 2003). Furthermore, the mechanisms that allow for flexibility in response to environmental cues can themselves become disrupted, such as the decline in neural plasticity witnessed in Alzheimer's disease, Huntington's disease (Spires & Hannan 2007) and fragile-X syndrome (Martin & Huntsman 2012). While some genetic mutations could be considered 'constitutive' constrictions (e.g. the genetic aspects involved in

familial hypercholesterolemia or in Huntington's chorea), this account suggests that until they manifest, they would be anomalies. That does not mean that having them is harmless, but it might better capture the progressive nature of such conditions: one can be at risk without being diseased, even if some anomalies will become pathological in all cases.

Does a problem arise, however, when trying to understand immune responses? More specifically, is there a difficulty in distinguishing healthy and allergic immune responses within this framework since an allergic reaction would seem to be an instance in which flexibility is not diminished but is nonetheless working against the organism? Firstly, a typical immune response to various microbes and antigens is to become activated such that a minor change in the organism (e.g. slight fever, mild pain) is coupled with the production of antibodies which will serve to fight off similar infections on future occasions. As such, this response is a matter of increasing the immune system's capacity for tolerating variations (e.g. various microbes) by increasing the variety and efficacy of antibodies so as to overcome such temporary activations and to help target future threats. This change thus entails an increase in robustness. Furthermore, this robustness is coupled with the flexibility to be able to adapt to new threats (e.g. adaptive immune responses) that have yet to be encountered as environments change and as the immune system itself goes through various fluctuations (Bateson & Gluckman 2011, pp. 42, 54). Such activations of the immune system thus increase the organism's ability to maintain such flexibility amidst variations.

Such flexibility, however, entails that the immune system is essentially open to threats and at any time can either start to produce antibodies which actually remove endogenous molecules or cells, as in autoimmune diseases, or can lead to an excessive reaction to various antigens, as in allergic reactions. The problem here is that the immune system is still exhibiting flexibility and yet there is a pathological condition. In fact, with autoimmune diseases, the immune system's flexibility could be said to be 'misdirected' as it removes or attacks what is typically present in the organism. As such, it is pathological insofar as this misdirected flexibility undermines a robust reaction to (tolerance of) internal variation. The problem is similar with allergic reactions in that the hypersensitivity to allergens is characterized by the immune system's becoming intolerant of previously normal external variation. Thus, in both instances the organism is less able to adapt to changing demands as its robustness is restricted, thereby constituting the pathological condition.

Thus, certain mechanisms are flexible in that they can allow for new physiological norms to arise in the face of varying demands. Under the right conditions, however, such flexibility can undermine the organism's capacity to maintain various functions, making it less robust, and as such can lead to a pathological condition. Like robustness, then, flexibility by itself is also insufficient to understand health and disease since it too can become pathological. This would provide further support for Canguilhem's claim that no biological fact is normal or pathological in itself. By incorporating both aspects we could better address such paradoxical situations whereby normal responses can be temporarily pathological.

3. Defining Health and Disease via Robustness and Flexibility

With these considerations in mind, we are better equipped to understand the contemporary relevance of Canguilhem's contextualist and surnaturalist approach to health and disease. Recall that his contextualist approach implies that health and disease are to be made relative to a given organism in its environment, while his surnaturalism suggests that 'normal' functioning is a matter of dynamism and adapting to the changing demands that an organism faces. With these properties, organisms are characterized by their 'experience, that is to say, improvisation, the utilization of occurrences' (Canguilhem 2008, p. 90). Consequently, it is from within Canguilhem's conceptual framework that robustness and flexibility become relevant for understanding health and disease.

Tying together Canguilhem's insights with these biological properties, I would like to propose the following conceptualization of health and disease. Health could be defined in terms of *robust organismic flexibility*, with a healthy organism being one which *maintains its organizational (robustness) and physiological (flexibility) capacities amidst changing demands.* Conversely, disease could be defined in terms of an *unstable organismic constriction*, where the diseased organism experiences a *set of processes resulting in an unstable constriction of its current organizational and physiological norms in its environment.*

Let us take a moment to deconstruct these definitions. First, health involves two aspects: the *organizational* aspect of robustness entails the toleration of internal and external variations, which is coupled with the *physiological* aspect of flexibly adjusting, establishing new

norms, amidst changing demands[133]. Health thus refers not only to how an organismic system is structured, but how this organization is maintained. While breathing, heart beats, etc. have a sort of 'inflexible' quality to them, they are physiological as they maintain the structure and functions of the organism, and as they vary as a function of changing demands. Second, as what an organism is capable of tolerating changes as a function of changing demands (both internal and external), this would imply that there are degrees of being healthy. An organism that can only live under very controlled conditions will have a precarious degree of health, with the threshold of disease being more easily breached, but it will still be healthy relative to those conditions. This would capture Canguilhem's contextualism, since an organism's norms can change as environments change, as activities change, and simply due to aging. It also captures his surnaturalism, since health is not a matter of whether the organism conforms to species-typical or etiological norms, but whether its own norms change as demands change, whether they are 'more than normal' in a given environment.

Third, claiming that health is a matter of robust flexibility does not imply that organisms are healthy only insofar as they can move in and out of different environments; rather, the implication of contextualism is that it is only relative to a given environment that such a judgment can be made. Healthy behavior or physiology in one environment could become pathological in another, but this is only determined *in a given environment.* Fourth, since robustness and flexibility are relational concepts, they also incorporate how physiological changes can reflect the construction of the environment in which the organism lives. Health is thus not localized within some part of the organism, but is a matter of the *relation* between the whole organism and its constructed environment. This is important because it opens the door for the role of social and cultural norms in shaping human health and disease. Finally, since organisms are characterized by their *systemic* organization (e.g. Pradeu 2010) which is maintained in a given environment through various adjustments (flexibility), health is determined based on how a given variation affects the *organismic* level of organization and function. Whether a given variation will be considered pathological depends on its effects for the organism as a whole. I will return to this in the next section where I consider some ways to operationalize these definitions.

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[133] One conceptual consequence is that physiological norms are not best described as 'states', a term one finds quite often, e.g. Ereshefsky (2009). By linking health and disease to behavioral capacities and abilities, my approach comes close to that of Nordenfelt (2007), who was himself influenced by Canguilhem. As such, health and disease are not definite properties but pertain to dynamic relations between the organism and its environment.

Moving on to disease, there are several interesting consequences here as well. First, the most salient aspect is that disease is not simply defined in opposition to health, but has its own properties. While formally disease is contrary to health, in content these concepts refer to qualitatively different processes: health is not the mere absence of disease. Second, the organism is unstable for two reasons. On the one hand, the pathophysiological processes operating within it can have various outcomes ranging from recovery to chronic illness to death (Nervi 2010). On the other hand, with the exception of death, these variations force the organism to adapt or to constrict its norms. As I discussed above, this can result in a narrower range of functioning (e.g. less robustness or less flexibility) that, while allowing the organism to survive, leaves it unstable before environmental demands. As I am assuming the view that organisms are complex adaptive systems, disease would also likely involve a threshold effect whereby a quantitative variation produces this qualitatively different functioning. Disease can thus be said to have a negative value as this qualitatively different functioning involves an unstable reduction or constriction of the organism's capacities. This reflects Canguilhem's (sur)naturalistic approach to valuation.

Third, this shift will likely vary between organisms, implying that the individual organism's norms relative to its environment will be a necessary condition for determining the threshold[134]. In other words, whether a given trait, function, or general variation will result in a disease will likely vary from individual to individual. This is what is captured by saying that each individual has their own unique disease and would imply a more patient-oriented approach. The individual organism's norms determine the line between health and disease, whereas the 'role' of doctors or pathologists is to determine which disease is present and its peculiar pathological consequences for the given organism. Fourth, as this threshold varies as a function of organismic norms and environmental demands, diseases also come in degrees. This will likely be partly influenced by the specific disease (e.g. cancers might vary in different ways than infections) and partly by the organism's current physiology and environment. As organisms adapt to changes, their norms are always relative to their current capacities and current demands, which will influence the severity of the disease.

This approach could suggest an answer to the problem of anosognosia. Where individuals seem blind to their condition, e.g. Alzheimer's disease, the role of the doctor is to

[134] Due to the variability and complexity of organisms, it is possible that universal (i.e. necessary *and* sufficient) conditions cannot be given. We may have to start with certain necessary conditions and go from there.

help the patient understand that a deviation is actually occurring, e.g. brain deterioration, that can have negative consequences e.g. confusion, memory loss, mood swings, and eventually death. If disease is a biological phenomenon, then the point is not necessarily that the deviation is negatively valued *by* the organism in a conscious sense, but that it is negative *for* the organism as it constricts organizational and physiological capacities. The problems associated with Alzheimer's disease would be pathological as they constrict the individual's capacities and it is up to the doctor to determine the extent and possible significance of these changes relative to the given individual. It is possible that examples similar to Alzheimer's would be better described in terms of conditions that progress from anomalies to abnormalities. While this is a possible response, I admit that by making disease relative to the individual organism's norms, this issue remains problematic.

Finally, this view helps to explain Canguilhem's claim that pathology cannot be derived from physiology since different biological norms are at work. The unstable constriction that constitutes disease pertains to *pathophysiological* processes (Nervi 2010), which, as I mentioned, are distinguished from physiological processes in that the former have variable outcomes (from recovery to death) and no clear limit to their severity (except for death). They also have unique causal chains that need not be confined by physiology, e.g. a disease process can disrupt physiologically distinct systems. The specificity of disease, then, is explained by the fact that the constrictive norms of disease produce qualitatively new causal sequences and *pathological* functioning. Also, if disease is not necessarily normal functioning that has gone awry, but is a peculiar kind of functioning that leads to different biological events, then interventions would not be a matter of 'returning' the organism to previous norms, but would entail the disruption of these pathological causal processes with an aim to help the organism establish a new norm. This seems to better capture what actually happens in medical practice.

Summing up, all organisms exhibit a responsiveness to their environment and it is this that allows us to distinguish healthy and pathological norms: bacteria and archaea have the capacity to fall sick and die (through metabolic disruption and lysis caused by bacteriophages), as do plants, fungi, and animals, all of which point to a constraint on their capacity to tolerate variations and their ability to establish new norms. Without evoking desirability or any conscious sense of valuation, it seems biologically accurate to argue that all living organisms, from the infections of the tiniest of bacteria to the pathologies of the largest of mammals, can undergo unstable constrictions, thereby struggling or failing to meet internal or external

demands. Consequently, it seems correct to argue that health and disease are properties inherent to living beings (Canguilhem 2012; Morange 2008a). What these properties mean for bacteria or plants will certainly be different than what they mean for different animals, and they will even be different among organisms within a given species, but that does not undermine the naturalist aim to apply these concepts throughout the living world.

4. Possibilities for Operationalization: Ecological Fitness and Allostatic Overload

One problem that often haunts philosophical attempts to define health and disease is that it is rather difficult to operationalize these concepts. In other words, it is difficult to determine how they can be amenable to measurement. With my approach, this difficulty is particularly acute since health and disease are not biological states, but involve dynamic processes that can vary between and within organisms and even across environments. Furthermore, since health pertains to what organisms are capable of tolerating and doing as demands change, it is a property that in some sense defies analysis and objective determination. Nonetheless, I would like to suggest two ways that this might be done.

Probably the most common approach to operationalizing health is to make it a function of (statistical) fitness, or the average contribution to survival and reproduction of an average individual with a certain genotype or phenotype (e.g. Boorse's claim that normal functioning entails efficient species-typical causal contributions to individual fitness). The question, however, is whether this approach to fitness is appropriate for medicine. As I have already mentioned many problems with referring to reproduction, it seems that we need to decouple survival and reproduction. A relevant account of fitness also has to incorporate environmental conditions. As my position is contextualist, the most relevant candidate would then seem to be that of 'ecological fitness', which is the more traditional idea concerning how an organism 'fits' its ecological niche. This can be defined in terms of 'those traits, dispositions, and *properties of organisms* that tend to suit them for (and are thereby explanatory of) survival', with survival being 'not *merely* reproduction' (Peacock 2011, p. 102; emphasis added). This definition helps to account for how that which contributes to survival involves the complex interaction between organism and environment, how the organismic construction of environments creates feedback loops whereby organisms are forced to adapt to the ecological changes that they brought about, and how environments can be composed of and are shaped by other organisms (2011, p. 102).

Another interesting aspect is that it allows for different ways in which ecological fitness can be demonstrated, e.g. competing for more ecological space, cooperating so as to share the ecological space, and constructing a larger ecological space (2011, p. 103). As ecological fitness is defined as an organismic property that is not necessarily linked to reproduction and which helps to explain an organism's survival under dynamic environmental conditions, it seems like a good candidate.

Understood in this sense, then, health could be determined in terms of how various traits (from the molecular to behavioral) contribute to the organism's maintenance of its organizational and physiological capacities, and thus its survival, in its environment[135]. Since an organism's survival depends on flexibly responding to environmental demands, an organism will be ecologically fit and thus healthy as long as these capacities are maintained in a given environment. Conversely, an organism whose norms are constricted and unstable before environmental demands would be one whose survival is threatened. Moreover, with robust flexibility, survival would not merely imply self-preservation as this is already a restricted form of living, but is a function of the complex dynamic between how organisms adjust and adapt to their environments (cf. Canguilhem 1994, p. 355). The explanation for why some organisms survive and others do not could thus be based on the maintenance or constriction of the properties of robustness and flexibility. While promising, the main problem with this suggestion is that it remains somewhat vague.

Another way in which this could be operationalized would be by appealing to the studies surrounding the physiological property of allostasis. Recall that allostasis refers to physiological variations that allow organisms to adapt to changing life history demands, e.g. weather, predators, pollution, or social interactions. Over time, such variations take their toll in terms of bodily strains or 'wear and tear' and within limits this toll or 'allostatic load' is tolerable. However, allostatic overload can occur either when 'energy demands exceed energy income' or when an environment chronically induces coping mechanisms regardless of energy resources (McEwen & Wingfield 2003, p. 4). With the former kind of overload, the body often

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[135] A similar claim is made by Nicholson (forthcoming) regarding the maintenance of organization: 'The very existence of an organism depends on the effects of its own activity. This means that an organism's activity is intrinsically relevant to itself. Such intrinsic relevance generates a naturalized criterion for determining what norms the organism *should* follow. An organism (as well as its parts) *must* act in accordance to the particular operational norms that enable it to maintain its organization through time. If it stops following these norms, it ceases to exist. It is therefore possible to speak of what is intrinsically "good" or "bad" for an organism by evaluating its activities and actions according to the contribution they make towards the maintenance of its organization' (p. 10). (As this article is not yet published, I refer to its current pagination.)

goes into a sort of emergency life history stage where self-preservation mechanisms are triggered so as to reduce the overload and survive the perturbation, which often entails changing environments[136]. The latter kind of overload can be more pernicious as it is accompanied by environmental conditions that continually induce allostasis, e.g. people with low socioeconomic status or those living in a difficult social environment developing chronically increased hormonal secretions coupled with (or evoking) elevated food consumption, fat deposition, hypertension, and weakened immune systems (McEwen & Wingfield 2003). In such chronically restricted conditions, no escape response or self-preservation mechanisms are triggered to overcome the problem and so alleviation only comes when the pathogenic (social) conditions are changed[137]. By acknowledging that environments shape health and disease, therapeutic interventions would likely become more socially oriented (Sterling 2004; Schulkin 2011).

While measuring how allostatic load and overload alter organismic energetic capacities is still an open issue, the typical suggestions for doing so are in terms of biochemical hormonal changes, e.g. the ways in which life stressors affect biochemical 'mediators' such as glucocorticoids, cortisol, adrenalin, cytokines or parasympathetic activity (McEwen & Wingfield 2010). Since hormones are 'literally at the interface between genes and environment' (Pigliucci 2001, p. 124), their effects on an organism's flexible (or allostatic) behavior in its environment should reflect its health. If it is true that hormones are the 'unsung heroes of the nature-nurture field of study' (Pigliucci 2001, p. 124), then studying these allostatic mechanisms could greatly help to clarify how health and disease are a function of maintaining robust flexibility amidst environmental demands and stressors, which implies survival[138].

One difficulty with using allostatic measures is that in these studies disease is not only that which can occur due to these types of overload, but is also described as one type of stressor that contributes to allostatic load (McEwen & Wingfield 2003, p. 4). The question, then, is whether allostatic overload is a sufficient or merely necessary condition for pathology. One way to address this could be to better specify the conditions which determine when allostatic

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[136] Interestingly, Canguilhem's (1989) discussions of Goldstein's theory of 'catastrophic reactions' is quite similar to this kind of allostatic overload. As I discussed in chapter 3, Canguilhem also frequently refers to the work of Hans Selye, an early pioneer in the field of stress and its physiological effects.

[137] This claim will be further explored in the next chapter where I look into how certain socially-induced pathologies might be best 'treated' not by focusing on the individual, but by changing the social conditions, e.g. social norms, contributing to pathogenesis.

[138] Furthermore, it might also be possible to combine studies on allostasis with evolutionary concerns (e.g. Korte et al. 2005).

overloads occur and determine whether each disease, or class of diseases, can be formulated in terms of allostatic overloads. For example, it is claimed that diseases can arise when a threshold is crossed in terms of a 'dysregulation' of allostatic mediators (McEwen & Wingfield 2010, p. 7). We would need to determine how and when this 'dysregulation' involves a restriction on an organism's organizational and physiological norms, consequently undermining its chances for survival.

In order for either of these proposals to work, we have to incorporate the insight that the shift from health to disease is not linear, but involves a complex network of levels relative to a given organism in its environment (species, age, sex, current level of health, social status, etc.). As a result, this would not involve a focus on how cases conform to types, but on what is unique about each case, i.e. the variations relative to an organism's norms for maintaining flexibility at this time and in this environment. This is what is suggested by 'individualized medicine' which recognizes that 'variation is there in every individual and that, when there is disease, each person's version of it must differ, whether subtly or obviously' (Childs et al. 2005, p. 324). The importance of variation can be demonstrated, for example, in terms of how genetic mutations, immunological uniqueness, or life history causes of degenerative diseases, all require individualized treatment (Henneberg & Saniotis 2012). An organismic focus would need to explain why a given organism has this specific disease at this time in its life. This is likely to be a considerable challenge, but it seems that if ecological fitness or allostatic overload can be brought together with the properties of robustness and flexibility, then we might be better able to specify the complex transition from health to disease and vice versa.

5. Concluding Remarks: Towards an Eco-Organismic Medicine

Now that this account of health and disease has been sketched, I want to conclude by discussing how it is able to deal with various problems raised in this dissertation, focusing particular attention on the evolutionary concerns discussed in the previous chapter. First, by starting with actual biological properties (robustness and flexibility; instability and constriction), this could allow for a *naturalization* of these concepts. While it is possible that other properties could turn out to be better suited for health and disease, a truly naturalistic approach should begin with empirical rather than conceptual issues. Second, referring to robustness and flexibility captures organism-level properties (organizational and physiological) and these

properties can be understood without appealing to past selection history. Of course these are evolved properties, but their past selection history is not decisive for medical considerations. As a result, unique or 'instant' organisms, e.g. foreleg-less goats, can be considered healthy relative to their own organizational and physiological capacities, and can also be diseased in ways in which others are not. This has several implications regarding evolutionary approaches.

First, recall that there were several empirical issues raised when trying to bring evolutionary considerations into medicine. One of these issues turned on the claim that past norms and selection pressures shape what is currently considered 'normal' in the sense of various genetic and physiological aspects commonly found in our species. However, a deeper look into the biological phenomena of phenotypic flexibility and robustness suggests that organismic adaptability plays an indispensible role in understanding current physiological norms. As a result, the role of the EEA is minimized when trying to discern what humans are capable of in their environment. This leads to the interesting conclusion that since organisms are not only shaped by their past, but construct their present, healthy behavior is that which allows organisms to *offset* potentially problematic 'mismatches' or evolved constraints. Such compensations can be seen, for example, in physio-behavioral changes allowing organisms to thrive 'outside their "normal" range' (Piersma & Lindström 1997, p. 137), or when the costs of developmental plasticity are mitigated due to this within-individual reversible variation (Piersma & Drent 2003, p. 231). Some examples of this would be adaptive immune responses, changing behavior to avoid dangerous new environments or to cope with food shortages, or altering organ size as environmental pressures change (Piersma & van Gils 2011). Such flexible compensations are not confined to the body and can also have ecological consequences (Miner et al. 2005) whereby a 'mismatched' environment is made more hospitable: from plant's excreting chemicals to humans producing social institutions to understand how to improve their living conditions.

Second, in the three Darwinian accounts discussed in the previous chapter, there were also conceptual problems in how health and disease were understood relative to past norms. A contextualist approach would help to avoid the problem of pathologizing normal variations by stressing the need to make diagnoses relative to the 'whole' organism, i.e. relative to the organism's unique physiology, life history, chosen or imposed activities, as well as to the species, age and sex groups to which it belongs, and to the geographical, social, and cultural environment in which it lives its life. We have seen that internal and external variations are in

themselves insufficient to conceptualize an organism's health or disease precisely because these latter concepts entail the organism's dynamic relation to its environment. Significant deviations from evolved norms would be pathological not solely because of their deviation but *depending on the chosen or imposed environmental demands*. The example of dyslexia as being an anomaly in a non-literate environment or potentially an abnormality in a literate one provides a telling example. The cases of lactose intolerance and gluten sensitivities could be further examples in which an individual is only to be considered pathological in an environment where such variations produce unstable constrictions, e.g. in environments where dairy and wheat are consumed. This could prevent over-pathologization by suggesting that 'normality' is better thought to include a wider range of viable behaviors in the face of different demands.

Third, this view would suggest that we rethink the foundational status of evolutionary biology for medicine. There is some promise in the new science of Darwinian or evolutionary medicine such that it helps to show how the past can indeed 'explain the present' in terms of adaptations and even the fact *that* we are vulnerable. However, what this means for health and disease requires that we also know *how and in what ways* we respond to and shape our present because it is during our lifetime that we are healthy or sick. If we take Canguilhem's understanding of medicine seriously as an 'art at the crossroads of *several* sciences' (1989, p. 34) then maybe evolution is less 'foundational' than merely one science among many which all contribute to an adequate understanding of health and disease. While such attempts to put evolution in its place have been made by others, what is unique here is the suggestion that we should take the 'historicization' of health and disease more seriously such that it is not relative to past norms that we determine health and disease, but relative to the organism's current physiological and environmental conditions. Microbiologist René Dubos expresses a similar model for health when he writes:

> it is not possible to define health in the abstract. Its criteria differ with the environmental conditions and with the norms and history of the social group. The criteria for health are conditioned even more by the aspirations and the values that govern individual lives. For this reason, the words health and disease are meaningful

> only when defined in terms of a given person functioning in a given physical and social environment[139] (1965, p. 351).

While Gluckman and Hanson interestingly call for an 'eco-devo medicine' (2006, p. 204) so as to include the role of the environment in understanding organismic development, maybe it would be better to develop an *eco-organismic* medicine so as to incorporate the unique and historically contingent concatenation of influences, from the genetic to the ecological, that constitute the health or disease of the 'whole' organism in its environment. Such an approach would better account for the persistent fact that it is, after all, the suffering of the whole organism with its unique life history in relation to particular environmental conditions that medicine aims to alleviate. With an eco-organismic approach, it is the organism's norms in its environment that are decisive for medical judgments.

Finally, this approach would help to narrow the gap between naturalism and normativism such that health and disease are not only relative to the physical environment, but also the social environment. That does not mean that human health and disease are purely social phenomena or are reducible to desirability, but that they refer to physio-behavioral norms which cannot be understood without a reference to the unavoidably social and cultural environment in which they occur. However, this leads us to yet another problem. If an organism's robust flexibility or unstable constriction is relative to a given social environment, does this imply that health entails adjusting to society and disease entails some deviation from social norms? Does this view lead us back into the problem of social control?

[139] His suggested definition of health as 'a physical and mental state fairly free of discomfort and pain, which permits the person concerned to function as effectively and as long as possible in the environment where chance or choice has placed him' (1965, p. 351) also comes close the one developed here.

Chapter Seven

Contextual Consequences: From Social Pathologies to Social Norms as Pathogens

> Hence we are driven from the individual back to the social structure. If there is a taint, it lies not in the "soul" of the individual but rather in that of the environment… The prognosis is in the hands of those who are willing to get rid of the worm-eaten roots of the structure.
>
> Frantz Fanon, *Black Skin, White Masks*

There has been a recurrent problem in this dissertation when trying to clarify what exactly is at stake in relativizing or contextualizing health and disease. This problem surfaced at the end of chapter 2 when I discussed the claim that 'environmental relativity' seems to lead to the conclusion that being homosexual in a homophobic environment could be pathological. While this conclusion is not without its problems, it does seem to be a result of arguing that disease is to be understood in relation to an organism's capacities in its environment, as I discussed in the previous chapter.

The issue can be illustrated by looking at some examples. First, it is clear that if an organism finds itself in an environment to which it fails to adapt, this environment will likely result in a constriction of organismic functionality. This was mentioned in the previous chapter with regards to a human failing to adapt to extreme conditions (e.g. lunar conditions), but could just as easily be seen in a human trying to live in a heavily polluted environment. The suffocating and reduction in lung functioning will be experienced as deviations that constrict organismic capacities in that environment, hence constituting the pathological condition. Of course, this can also lead to further complications, e.g. lung cancer, but it is the initial deviation that is experienced as pathological. A slightly more interesting example could be that of someone with hypertension living at different altitudes. If a hypertensive individual moves to a high altitude (where the reduced oxygen levels (hypoxia) lead to an increase in blood pressure and heart rate (Bärtsch & Gibbs 2007)), their hypertension can produce constrictive symptoms (e.g. fatigue, palpitations, chest pains, nausea) and thus can be experienced as pathological, whereas in lower altitudes it might pose no problem. Here, there is something in the individual that contributes to making its condition pathological in that environment. This helps to

explain why for other individuals such a change in altitude might pose no problem, e.g. someone with hypotension.

The question that arises, then, is whether human social environments can also play a similar pathogenic role. As the human environment is not merely physical but is thoroughly constituted by social norms, i.e. the behaviors, expectations and perceptions of ourselves and others, are there some instances in which being X in social environment Y could be pathological in a similar way to the above examples? As I have mentioned several times, it has been argued that dyslexia is such an example whereby the social valuation of literacy could produce harm and thereby render the underlying dysfunction a disease, depending on the individual. The issue to be explained, then, is the following: if living in certain social environments can produce pathological norms, does that imply that health is merely submitting to or complying with social demands?

If we take up Canguilhem's claim that neither an individual organism nor the environment can be pathological in themselves, but only *in relation to one another*, then what needs to be clarified is why some individuals[140] experience this environmental relational as pathological, whereas others do not. In this chapter, I will first discuss the issue of social relativity by looking at some examples of harmful social situations. I will ask whether the fact that some individuals experience their relation to the social environment as pathological should be interpreted as them living in a *society* that is pathological (Fromm 1955), or because some social *relations* are pathological (Wakefield 2006), or whether there is something about social environments that can produce 'social infections' whereby an individual's norms become experienced as constrictive and thus pathological. After showing the limitations with the first two approaches, I will then explore how this third approach could help to clarify Canguilhem's contextualism insofar as norms play a causal role in shaping organismic normativity. I will then take up a suggestion by Murphy (2006) that social norms are interesting for pathogenesis insofar as they contribute to the formation of pathogenic 'niches' wherein an individual experiences its own norms as restrictive. This might help to explain why homosexuality can be experienced as pathological in some environments. While it might seem trivial to say that some social norms can be harmful, e.g. racism or discrimination, the interesting question that I will explore is whether pathologizing is necessarily harmful in these instances, and whether, by

[140] Since this chapter focuses on humans, I will be using 'individual' and 'organism' interchangeably, while acknowledging the insights of the previous chapters.

situating the cause in the individual's relation to social norms, this would entail a social, rather than an individual, intervention in the form of 'medicalizing' social norms. If this account is accurate, it might not merely help to show how social norms contribute to pathogenesis, but also how these norms could be changed by the same institution that is usually accused of fostering social control.

1. The Problem of Contextualizing Diseases: Can There Be a Social Pathology?

One way of entering into this debate could be to explore different ways in which social norms seem to be harmful by producing what could be called 'social pathologies'. What exactly are these pathologies and on what level should they be understood? The following two examples pertain to instances in which it might be pathogenic to follow social norms. One interesting example of this could be found in Erich Fromm's discussion of what he calls a 'socially patterned defect' (1955, p. 15), which is a defect that has become normal for a given society or population. A 'defect' – presumably a dysfunction of some kind – could arise when individuals are incapable of attaining freedom, spontaneity, and self-expression, all of which, according to him, are objective human needs. A 'socially patterned defect', then, implies that all individuals in that society share it, making them unaware that it exists. Since the behaviors or thoughts peculiar to that 'defect' are valued by that society, the presence of them in an individual aids social acceptance. The example he gives to illustrate such a defect is that of individuals living in a Calvinist society where it is normal and culturally valued to feel powerless, unworthy, and riddled with guilt and anxiety concerning the afterlife, ultimately rendering the individuals servile to their society (1955, p. 15). This set of behaviors and feelings, produced by this 'sick' society, is what allows them to fit in and be accepted. Fromm concludes from this that since it is pathological to be normal and since the society does not satisfy objective human needs, the *society itself* can thus be said to be sick.

While problematic, this example and the conclusions he draws from it allow for some interesting issues to be raised. First, by appealing to some 'objective' needs of human nature (e.g. relatedness, creativity, rootedness, sense of identity, frame of orientation), he seems more interested in determining whether societies influence *well-being* or happiness, rather than health per se. It seems quite plausible that a person could have most if not all of those needs met without being considered healthy, possibly even some individuals in the society he

describes. If health comes from obtaining these needs, then it is probably the case that most people are unhealthy most of the time. If such health is unattainable, it is questionable whether it is a good way to think about health[141]. Secondly, there is the conclusion that where such defects are statistically normal, the *society* should be considered sick (and conversely, where the objective needs are met, the society is 'sane'). As I pointed out in chapter 3 in relation to Giroux's claims about 'population health', it is rather problematic to consider a non-living entity, such as a human society, as sick or diseased. Of course, some societies can be more pathogenic or salubrious than others, but that does not make the society itself sick. Consequently, even if strict Calvinist societies produce some behaviors and thoughts that those of us who do not belong to that society consider to be unhealthy, as the individuals value their beliefs it is not clear that their potential unhappiness would be sufficient to warrant an intervention. Improvements are also not likely to be facilitated by ascribing some ontological status to the society as a whole.

There is, however, a second way to think about situations in which it is pathological to be normal. In other words, there are situations in which following the norm or fitting in can be detrimental to one's health. For example, one could imagine a society where it is normal, and socially valued, to consume high quantities of alcohol on a daily basis (Murphy 2006, p. 271). In such instances, this behavior can easily lead to pathologies such as addiction, cirrhosis or even liver failure. If the social norms are stable, however, such that the behavior becomes statistically normal over time and its value more socially ingrained, then on what do we base disease judgments? If alcohol addiction, or dependence syndrome, is statistically normal for, say, human males of a certain age, and its socially-valued status entails that by inducing it one will likely increase reproductive fitness, then it seems that Boorse would struggle to say that the condition of dependency is pathological, at least for that reference class. He could always appeal to a larger reference class (e.g. all human males of that age) or to the likely pathological effects of such dependency, but there is still the issue of it being fitness-enhancing in that environment. A similar problem seems to occur even if we take a hybrid approach. While Wakefield would likely label the dependency dysfunctional relative to evolutionary norms, he

[141] This is also a common critique of the WHO's definition of health as 'complete physical, mental and social well-being' (e.g. Dubos 1959).

would struggle to consider it a full-blown disorder since it would be socially valued[142]. Of course, if we ask whether a larger group values or disvalues such behavior, it might allow for his socially-determined harm component to work, but insofar as it is statistically normal and aids socialization in a given society, it would be hard to pathologize it according to his account.

It seems, then, that when trying to understand this 'pathological normality', labeling the society itself as pathological is unwarranted. If it is not the society as a whole, then maybe the diagnosis could focus on social *relations*. This is what Wakefield suggests in his article on 'relational disorders' (2006) where he asks whether some relations are not only harmful (socially disvalued) but also failures of naturally selected relational functions (evolutionary dysfunction). In these disorders, the relevant function or dysfunction is not to be found in the individual, but in the *interaction* between otherwise 'normal' individuals. As such, there is a dysfunction of a naturally selected relational mechanism resulting from 'an imbalance between traits or structures in different individuals that are each within normal range' (2006, p. 424). He is careful to point out that relational dysfunction is not the same thing as a 'dysfunctional relationship', the latter being merely a 'negative or problematic relationship that is not meeting the partners' or society's needs' (2006, p. 424). Relational disorders are thus not merely 'problems in living'. One example of a relational disorder could be seen in a 'mismatch' in temperament between a mother and an infant (2006, p. 425). In this example, the infant exhibits a low, but still statistically normal, tolerance for frustration and the mother exhibits a rather high, but still statistically normal, delay in response to infant crying. As a result, the infant tends to experience high levels of anxiety as it cries without being sufficiently consoled by the mother. This rather harmful situation for the infant is coupled with the failure of what would likely have been part of the naturally selected mother-infant bond: 'an adequately speedy and reassuring response by the mother to infant crying' (2006, p. 425). As harm is coupled with dysfunction, there is a relational disorder.

There are several important problems with Wakefield's account. First, similar to the problem that arose with Fromm (and Giroux), there is the obvious ontological issue of claiming that a relationship fits into the class of things that can become diseased. It is one thing to say that they are pathogenic, but another to say that they are pathological. Wakefield never considers this problem, but a coherent account of disease should entail that what is

[142] If values 'can disqualify a dysfunction from being a disorder' (Wakefield 2005, p. 89), then this would imply that while cultures can be wrong about whether something is a disorder by not properly determining that it involves a dysfunction (Wakefield 2007, p. 155), they cannot be wrong about their values.

diagnosed as ill is actually capable of being ill. Second, even if we accept his view, then we have to ask: as relationships will likely involve high degrees of variation (historically and culturally), some of which will be suboptimal and likely have equal effects on fitness, are *all* suboptimal variations in relationships to be considered disorders? If not, how are we to determine when suboptimal normal variation becomes dysfunctional[143]? Wakefield does point out that it is very difficult to distinguish bad from disordered relationships, in part because it is unclear 'what relationships are designed to be like, what they are selected for, and therefore what would constitute a dysfunction' (2006, p. 426). The problem that he faces, however, is not merely with the dysfunction component, but with how it relates to the harm component. In fact, it seems more accurate to argue that a relationship would only become dysfunctional *if sufficiently harmful* to the individuals involved. In other words, contrary to his assertion that without a dysfunction no level of harm can make one disordered (2010, p. 343), in those societies where the levels of harm and distress experienced are sufficient to reduce the individual's ability to meet some of the basic demands of social life, such as learning and adapting to social norms, this reduction would only become dysfunctional when sufficiently harmful. Here more than ever, then, Wakefield seems to collapse the distinction between harm and dysfunction, such that there could not be a harmlessly dysfunctional relationship. Moreover, if disorder judgments can be relativized to a given individual-society relation that has become harmful, then what would stop Wakefield from accepting the claim that homosexuality in a homophobic environment is also a disorder, especially if one's sexuality is experienced as restrictive in that environment? I will return to this in the third section. Finally, it is not clear, according to Wakefield's account, what an intervention would entail and whether it would bypass the problem of stigmatizing those involved. For example, in the case of the mother-infant mismatch, of course it might seem reassuring to point out that the mother and infant are both 'normal', but the fact remains that the 'disorder' would be treated if the mother simply changed her behavior. Saying that she is 'within normal range' would not necessarily prevent the judgment that her behavior is largely to blame for the infant's increased anxiety. Thus, due to the crucial ontological problem with pathologizing relations and the fact that his example actually blurs the line between harm and dysfunction, this does not seem to be a promising approach.

[143] As I showed in chapter 5, this problem plagues Wakefield's account on various levels.

If some social relations are harmful for the individuals involved, but we cannot diagnose the society or the relationships as sick, then what approach could be taken? Another obvious option would be to explore how social norms can be the *causes* of these pathological conditions. Dominic Murphy gives an interesting example of this in his discussion of dysthymia[144], which he defines as an 'affective disorder characterized by depressed mood for most of the day, for most days, extending over 2 years but without major depressive or manic episodes' (2001, p. 156), as well as the 'misperception of culturally appropriate norms of reciprocation' (2001, p. 157). In particular, they tend to view themselves as being more cooperative than they actually are, and tend to disvalue the help of others. This leads to the continual feeling of being cheated, which can in turn lead to being negatively treated, fostering social isolation and depression.

While one could argue that the cause of such misperceptions and depressed moods is likely to be found in some psychological or neurological impairment, or even that the beliefs entertained by the dysthymic individuals are dysfunctional (Wakefield 2000), Murphy suggests another option. It could be that the cognitive mechanisms of some dysthymic individuals are functioning normally and yet there is a disorder due to having received 'hopelessly deviant information about cultural expectations' (2001, p. 158). These individuals struggle to engage in society and meet the expectations of others not because they are incapable of doing so, but because their representations of social norms are so problematic as to preclude adherence to them. As such, by being irrational or distorted, the information concerning social norms produces pathogenic beliefs as it undermines the individual's ability to adapt to its social milieu via social learning (Murphy & Woolfolk 2000a, p. 245; Murphy 2006, p. 76). If it is plausible to suggest that since the cultural transmission of useful information concerning social norms, as well as adherence to these norms, are both adaptive (Richerson & Boyd 2005), then there would seem to be some evolutionary support for this account. This example helps to point out that some aspects of social relations – even something as seemingly innocuous as communication – can become pathogenic under certain conditions, producing a constricted organismic norm.

A similar example can be seen in the case of eating disorders such as bulimia which could result from how an individual struggles to live up to a prevalent and successful social norm, e.g. Western cultural representations of beauty (Murphy 2006, pp. 262-263). A woman who has internalized social ideals but is either incapable of attaining them due to physiological

[144] Murphy's account is explicitly based on the work of McGuire et al. (1994).

constraints or who struggles to overcome her desire to eat, could easily end up in behavioral patterns characterized by either food-avoidance or compulsive overeating followed by vomiting. However, as not all women in Western societies develop eating disorders, the variation needs to be explained. This might be done by studying how individuals differ psychologically or biochemically such that some are more susceptible to suffer when in the presence of such norms (2006, p. 262). Murphy argues that if this latter claim can be empirically substantiated, then it would seem that eating disorders are a mix of biological and social factors. The development of bulimia in certain social environments, then, seems to mirror the issue of how hypertension becomes pathological in certain physical environments. Here the interesting difference is that it is due to the internalization of social norms that one's difference results in unstable and constrictive behavioral patterns.

While we might be inclined to think that such 'social pathologies' are either explained by something within individuals (e.g. dysthymia or bulimia as mere brain dysfunctions), or that appealing to social causes implies that the pathologies are not 'real' (e.g. mental illness as a social construct), this view implies that it is often the interplay between an individual's unique biological makeup and social norms that creates the conditions for pathologies to occur. This could involve seeing psychopathology as 'the product of interacting natural and social explanations, perhaps on a spectrum from the almost completely natural to the almost completely social, with most forms of illness located somewhere toward the middle' (Murphy 2006, p. 276f). The suggestion that social norms can become pathogenic by producing pathological desires to conform to them would also allow for a more coherent way to think about 'social pathologies' without the problematic ontological issues mentioned above. In a strict Calvinist society, the norms involved could be lived as restrictions on the individual's norms, but whether such restrictions are pathological for the individual will likely depend on how the individual experiences its relation to the social norms. The individuals could be healthy in the sense that they are able to meet the demands of the society, and they may actually be happy to do so, but they could also be unlucky to have been raised in a rather strict society. That does not in itself constitute a pathological condition.

2. Social Pathologies and Pathological Experience in Canguilhem

The approach of Murphy to understanding social pathologies could be one way of interpreting Canguilhem's contextualism in that social norms can restrict an organism's normativity. Arriving at this conclusion, however, is not as straightforward as it might seem. On the one hand, Victoria Margree claims that, for Canguilhem, health 'is always a matter of relations and not a quality inherent in isolated features' (2002, p. 317). On the other hand, she goes on to claim that, for Canguilhem, society is not properly speaking an 'environment' because social norms 'present constraints with respect to which the individual has a choice, whereas environmental norms are determining for the health of the individual' (2002, p. 318). Societies and their norms are the result of choices, whereas environments (e.g. high altitudes) impose their norms onto individuals.

While Canguilhem does indeed distinguish between society as a 'systems of constraints' and environment as a 'system of determinisms' (1989, p. 282), his argument is more complex. The problem he points to is that by defining disease relative to social environments, this could imply that disease is merely a 'social maladaptation' and that we 'accept the idea that the individual must subscribe to the fact of such a society, hence must accommodate himself to it as to a reality which is at the same time a good' (Canguilhem 1989, p. 283). In other words, if disease is a social maladaptation, then health involves adapting to one's society. The question that he raises, however, is whether the 'adaptation' of living beings to their environments actually implies that the environment is merely a fact to be submitted to or a fact to be constituted (1989, p. 283). If organisms structure their environment while also developing their capacities, and if this is 'particularly true of environments and modes of life peculiar to man' (1989, p. 284), then it is not so clear whether societies are distinct from other parts of the environment since they too are constructed.

If human environments, then, are the result of our behaviors and choices, in what sense could they become harmful? Margree (2002, p. 318) suggests that some social norms, by strictly delimiting which behaviors or mental phenomena are considered normal, could take on a *pathological value* for some individuals. For example, the social norms of racism or the intolerance of mental deviancy could force the individual to restrict its behaviors and thoughts in that society and thus be experienced as pathological. While interesting, there is an ambiguity here between considering the norms to be pathological and pathogenic. For example, she claims that 'social norms *could themselves be characterized as pathological* if they restrict the possibilities for normative existence for those who live within them' (2002, p. 318;

emphasis added). However, she also claims that 'the social norm is not pathological for the social body, but may dispose toward the adoption of *pathological ways of being* for the individual who is subjected to it' (2002, p. 319; emphasis added). Due to the reasons mentioned above, the second option seems more interesting and plausible.

Can this latter suggestion, that social norms can become pathogenic, be one way of understanding Canguilhem's bio-social view of disease as involving 'crises in the effort undertaken to live up to a model of selected or imposed activities and, in the best of cases, to defend the values of or reasons for living' (2012, p. 41)? This suggests that health determinations should refer to the individual's relation to the models and values that it selects or are imposed upon it. This could also imply a more literal interpretation of the claim that when viewed separately, 'the living being and its environment are not normal: it is their relationship that makes them such' (1989, p. 143). The reason the same individual could be normal in one social environment and diseased in another is because of the interplay between the individual's values and way of living and the social environment, e.g. strict social norms. In other words, the relation between the individual and its social environment can become pathogenic when it produces an unstable and constrictive norm or 'pathological way of being' for that individual.

Understood in this way, Canguilhem's view seems to come rather close to that of Murphy's in his descriptions of bulimia and dysthymia as instances in which individuals become diseased due to their experience of the social norms under which they live. Dysthymic individuals experience a crisis in their effort to grasp social norms due to having received pathogenic information, and bulimics experience a crisis due to their inability to embody the cultural expectations to which they relate or which are imposed upon them. While with dysthymia the problem is that normal cognitive functioning becomes pathological due to the pathogenic information, in bulimia the pathological experience emerges due to an interaction between the individual's susceptibility and the pathogenic social norms. Could it be argued, then, that for some individuals, their problems emerge from living in a pathogenic 'niche' whereby social norms function as pathogens, leading to pathological experiences in those who are not robust enough to tolerate these pathogens? How are we to understand such situations?

3. Pathogenic Niches, Homonegativity, and the Pathological Experience of Deviancy

Theorists of cultural evolution often discuss the human ability to create, imitate, and internalize social norms, as well as the consequences of transgressing them. As social animals, humans have evolved complex socialization capacities whose various functions appear to include being able to imitate others, to internalize and adopt their behavior so as to best cope with the demands of an environment that is potentially hostile and often unpredictable, as well as avoiding the harmful effects of being ostracized (Gibbard 1990; Kurzban & Leary 2001; Richerson & Boyd 2005). These capacities can result in a tendency to conform to social norms, such that the more widespread a norm becomes the more effective it is in shaping individual behavior and the more resistant it becomes to attempts to change it.

Social norms are thus not merely the behaviors of a given group or society, but pertain to the, often unspoken, expectations and perceptions regarding one's place within that group. Humans first learn what is expected of them and how to conform or transgress these norms through socialization processes. However, knowledge acquired later on can also contribute to shaping one's sense of identity and place within the group. Over time, the norms become stable and come to 'fix' certain possibilities for how individuals behave and shape their identity. This stability of social norms, then, might provide a certain basis from which to understand how the line between normal and pathological can come into and out of existence. By employing the metaphor of an 'ecological niche', Ian Hacking (1998b) wishes to account for how some mental illnesses only appear in certain cultural contexts and for brief periods, such as dissociative fugue in France in the late 19th century. 'The marsupial rat and the Norway rat are distinct species inhabiting similar ecological niches, while mad Greek travelers and French fugueurs are similar species of madness inhabiting distinct ecological niches' (1998b, p. 55). Such illnesses come into existence due to certain social and medical factors or 'vectors' and fade away as those vectors fade[145]. In a passage that could just as well apply to knowledge in general, he writes that scientific knowledge 'changes how we think of ourselves, the possibilities that are open to us, the kinds of people that we take ourselves and our fellows to be' and this 'generates socially permissible combinations of symptoms and disease entities'

[145] The vectors he mentions (1998b, pp. 80-81) are a certain taxonomy (a vacant position in a medical classification system), cultural polarity (a deviant behavior is seen as both condemned and admired), observability (a system determining when one departs from social norms or customs), and release (it is an escape from everyday life). My intention is not to assess the validity of the vectors, but just to use his concept as it is developed by Murphy (2006) to think about the social-relativity issue. Murphy (2001; 2006, pp. 267-275) provides some nice critiques and amendments to Hacking's approach, some of which I will mention shortly.

(1998b, p. 10). Knowledge thus not only shapes what is possible for us to be, but also shapes what is possible regarding the roles of normal and pathological individuals.

Murphy (2001; 2006) goes on to strengthen this account by claiming that if some of these social factors remain stable across time, then this would explain why some mental illnesses persist, rather than being historical peculiarities. Going further than Hacking, he adds that these norms interact with variations in individual psychology and it is this mixture of the biological and social that can help explain many mental illnesses. 'If the norms are stable, then in each generation opportunities will exist for an interaction between norms and individual psychologies in ways that stably reproduce forms of mental illness, because some of the possessors of the individual psychologies are unable to follow or grasp the norms' (Murphy 2006, p. 270). Some psychopathologies, then, are not merely the product of social factors, but involve an interaction between social and individual factors. This is what explains the above example of bulimia. Those individuals who are psychologically susceptible, for various possible reasons (e.g. genetics, biochemistry, childhood experiences, etc.), to developing eating disorders will be more likely to have this susceptibility manifest as a disease upon internalizing strong social norms regarding beauty ideals. This would constitute a thoroughly bio-social account of disease similar to the one developed by Canguilhem.

A pathogenic niche could thus be understood as follows. Amongst various social aspects, a niche contains the commonly held beliefs and values of a group. These values can influence whether a given condition is understood as wrong, criminal, or even pathological. These values become reflected in the behaviors and expectations of the group (norms), which can lead to various forms of discrimination, stigmatization or criminalization. The social standards dictate how individuals are classified and treated, and shape the possibilities for normal and pathological behavior. These social norms will then become represented in different ways by the individuals within that society. In a pathogenic niche, this representation could take on the form of 'that which differentiates me, is not merely bad, but pathological'. This representation is expressed in the individual in different ways depending on the kind of pathological experience that the niche produces, e.g. the eating behaviors in bulimia. This representation also manifests itself in the individual's experience such that one feels guilty or ashamed at one's thoughts or behaviors. Could this description of a pathogenic niche help to provide more support for the contextualist claim that being X can be pathological in some social environments, but not in others?

The example of a pathogenic niche suggests that in many of the examples discussed in the first section, it is not the society, social relation or niche that is pathological, but that through a confluence of social and individual factors the niche produces constrictive individual norms (representations and behaviors) whose manifestations tend to be called 'mental illnesses'. While this might seem uncontroversial, the fact that many individuals actually experience their individual norm as a disease in their society, e.g. their particular sexual desires, might suggest that the issue regarding the medicalization of deviance is more complex than often assumed. In other words, medicalizing deviance is often described as a form of social control (Conrad 1992), but it can also contribute to removing the blame and stigma associated with non-conforming behaviors that arise within pathogenic niches (Davis 2010, p. 223). Before exploring this different outcome of medicalization, I first want to ask the following question: could the example of a pathogenic niche be applied to homosexuality[146] and, if so, what would it imply?

It is clear that heterosexuality is a norm that has served our species rather well in ensuring our continued existence. While some have argued that according to an etiological account of function (similar to Wakefield's) homosexuality is a dysfunction (Levin 1984), others have argued that it was an adaptation that promoted reciprocal altruism (Muscarella 2000) and that allowed individuals with lower social status to reposition themselves within the group (the alliance-formation hypothesis). This provides explanations for why it has been maintained by natural selection and was then reinforced in more recent history due to sociohistorical changes in the 18th century which led to exclusively homosexual relations (Adriaens & De Block 2006). On the one hand, then, some argue that homosexual behavior is neither adaptive nor an adaptation, but simply dysfunctional and possibly maladaptive behavior. On the other hand, it seems possible to argue that homosexual behavior is indeed an adaptation as it allowed for certain social benefits.

If there is something adaptive about homosexuality, why does it come to be experienced as a disease in some environments? If we can agree that being dyslexic in a society that values literacy can be pathological insofar as the individual experiences harm from the inability to adhere to that norm, then it seems plausible to argue that the distress felt by the homosexual individual who is suffering due to the strict homonegative norms and who is

[146] In what follows, I will just focus on the issue of male homosexuality. However, it is likely that the same issue could be applied to lesbians, transsexuals, and other forms of sexuality that tend to be discriminated against.

incapable of adhering to the dominate heterosexual norms can be sufficient to produce a pathological 'way of being' for that individual[147].

It seems possible, however, to remain agnostic about such evolutionary explanations by simply appealing to the social nature of humans and how being marginalized and isolated due to the prevalent social norms can have rather harmful psychological and physiological effects on an individual (Schulkin 2011), especially when those marginalized see themselves as responsible for their exclusion (Hall 1999; Lynam & Cowley 2007). Recall that in the conclusion of chapter 2, I mentioned how the social nature of humans implies that we are quite good at internalizing social norms. If the homosexual individual internalizes anti-gay norms, it is likely that he will feel guilty, ashamed, and even disgusted for having these desires or acting upon them. Consequently, in a heteronormative society, the labeling of homosexuality as a disease (or even a sin) could convince the homosexual individual that he is suffering from a disease, which can manifest itself in the individual's struggles to adapt his desires and behaviors to the strict norms of that society. Hence, regardless of the evolutionary explanation, in an environment where the sexual norm is predominately heterosexual and in which homophobia and the resulting discrimination are common, the relation between individuals can[148] become pathogenic such that homosexuality is *experienced as a disease for some individuals.*

Another way of approaching this could be to look at how changing social norms can have effects on individual health[149]. For example, recent epidemiological studies have shown the psychological or mental health impact of discriminatory social policies on LGB communities (Hatzenbuehler et al. 2010). In some communities in Massachusetts, for example, researchers were able to study the positive changes in overall health markers which occurred after the passing of same-sex marriage laws, such as fewer reported stress problems, fewer doctor visits, and spending less on health care, possibly explained by fewer 'status-based stressors' (Hatzenbuehler et al. 2012). Of course, these are only epidemiological correlations,

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[147] To be clear, I am *not* arguing that homosexuality is a mental illness and I feel that its removal from the DSM was justified and welcomed (cf. De Block & Adriaens 2013). However, the view developed here might explain the origins of ego-dystonic homosexuality in some societies and implies that the broader question of its pathological nature is more complex than previously thought.

[148] I say 'can' and not 'will' since the claim is that social norms can be sufficient to cause disorders, but will not necessarily do so depending on the nature and degree of discrimination involved as well as individual variations in how the individual values social norms.

[149] Of course, one could also enter into discussions of how societies with increasing levels of inequality can also become pathogenic insofar as inequality constitutes the social norm, but since the individual pathologies in such instances are so numerous and heterogeneous, I will set this example aside. Cf. Brunner (2007) for a discussion of the biological effects of health inequalities.

but the interesting implication that could result from them is that the problem lies not in the individual who is suffering, but in the society or niche that has produced that suffering. I will come back to this in the next section.

Initially, then, there seems to be something similar at work here as in Murphy's description of bulimia. In heteronormative and homonegative niches, homosexual individuals might suffer by being unable to live up to the norms of that society. While the suffering in Murphy's example takes the form of bulimia, here it could take the form of the individual actively trying to repress their sexual desires and behaviors. There does seem to be, however, an important difference. In the case of bulimia, the eating disorder is the pathological behavior that the individual suffers from, whereas in the case of homosexuals, it seems to be that the social norms cause other diseases, e.g. anxiety- or stress-related mental illnesses. Different options could be taken. On the one hand, it could be argued that due to how pathogenic niches shape individual experience, it is *the experience of being homosexual in a homophobic environment* that is the diseased condition, which then manifests itself in various ways, some of which we currently label as mental illnesses. On the other hand, we could remain agnostic about whether homosexuality 'is' a disease in homophobic environments, while still stressing that the individual's experience should be taken more seriously.

With these examples we arrive at a different way of conceptualizing social pathologies such that that which is causing the pathological condition is the individual's *relation* to their social or cultural environment (what Wakefield (2006) describes on the level of 'interactions'). The policing, discriminating, marginalizing, and ostracizing of deviants can contribute to the fashioning of a pathogenic niche wherein differences are lived as diseases. If a society strongly disvalues a certain behavior, e.g. homosexual behavior, and if the individual then convinces himself that this behavior is bad or pathological, the individual can perceive their desires as constrictive, as what prevent them from conforming. Moreover, the fact that the individual cannot stop their desires might help explain *why* it is pathologized at all, whereas the social norms explain *that* it is pathologized in this example. The continual presence of sexual desires becomes constrictive for the individual who has internalized the anti-gay norms. If this is accurate, then there seems to be more than just an analogy between arguing that someone living in a highly polluted or pestilent environment can become diseased due to the physical norms of that environment, and arguing that a dyslexic individual living in a literate society or a homosexual living in a homonegative environment can experience their deviancy as a disease

due to how their individual norms prevent them from conforming to the social norms. In all these cases, it is the *relation* to the social environment that makes the individual ill as the individual fails to adapt to the norms and demands of that society. By showing how social norms and their representation are the causes of this failure to adapt, a more complicated picture emerges than the issue of 'social maladaptation' that Canguilhem was worried about.

One could object that this is not a 'real' pathology, but merely the illusion of one since the individual is simply 'duped' by society into thinking he is sick. But is this objection really problematic? For example, what are we to make of the fact that the very labeling of something as a disease can also increase tolerance and remove certain social stigmas, as has been reported for obesity, ADHD, and alcoholism (Davis 2010, p. 223), and was even the case for many homosexuals in the 19th century who experienced their sexuality as a disease[150] (Oosterhuis 2000)? While there is some truth to the 'social constructivist' argument, the fact that individuals might welcome the diagnosis as it frees them of moral condemnation and self-disdain suggests that pathologizing could actually help individuals understand their own (pathological) experience. Consequently, the question regarding the 'reality' of such experiences is not very helpful. However, since the negative valuation (the pathological experience) arose due to having internalized strict social norms, the interesting question that emerges is whether the treatment is really best focused on individuals. It is very unlikely to help, and probably quite harmful, to force an individual to repress or eradicate such persistent desires. Instead, the individual could find relief from their negative valuation if the social norms change so as to become tolerant of deviance.

One problem with this approach is that it is rather difficult in practice to tease apart social and individual norms, largely because individual norms are thoroughly influenced by the cultural milieu. However, even if the individual's values have a social origin, that does not prevent one from arguing that such norms can become harmful to that individual, especially once they are internalized. In these instances it is not the deviation alone that would determine the pathological character, but the harm or distress inflicted on the individual. Moreover, individual variation suggests that while social norms can be sufficient to cause disorders, this is not necessary. If there is normal variation in the acceptance of norms, which are themselves neither universally understood nor universally adopted, then insofar as an individual, whose

[150] I set aside the important sociological and psychological differences between the cases mentioned. For now, the point is simply that many pathological experiences or behaviors seem to result from complex interactions in pathogenic niches.

norms differ from those of the society, does not experience any harm, there is little reason to call that individual diseased in that society.

Appealing to individual variation in experience, then, has two interesting implications. First, as I mentioned in the conclusion to chapter 2, I depart from Wakefield's account by arguing that even though a society might value reading, this is insufficient to deem a dyslexic individual disordered since that individual might not share the same values. I apply the same logic here, arguing that if there is something pathological about homosexuality in homonegative environments, then this would likely only be seen in those individuals who have internalized and share their society's norms or values. Some individuals might be more robust before these social pathogens. Second, this relativity should also go in the other direction, such that if the line between normality and pathology depends on individual conditions, then their experiencing their homosexuality as a disease could also be sufficient to support the foregoing argument.

If the individual's inability to adapt to the social norms is caused by those very norms then this position also poses an interesting problem in terms of treatment. Does this lead me into the problem of turning health and disease into a matter of conflicting values and social control? In an environment where homosexuality is experienced as a disease precisely because homosexuals cannot adapt to society's norms, should medicine seek 'psychological justice' (Wakefield 2006) by determining how these individuals can adapt to social norms, or would it be better to ask how *social norms can be adapted to the individual's norms*? In other words, if there is something pathological at stake here, should the treatment focus on the individual or the society? While it is the individual who determines the line between normality and pathology, there are many ways to cross the line again.

4. Values, Medicalization, and Normalization

Arguing that health and disease are to be understood relative to a given social-cultural context seems to lead us back into the problems that naturalistic and hybrid accounts, such as Wakefield's, have been trying to escape: e.g. an inability to adjudicate among contradictory values and thus being overly inclusive regarding medicalization. I would now like to question the severity of such problems by further exploring a naturalistic approach to values which sees them as natural expressions of organismic desires and behaviors. Such an approach might

allow for a different way to think about medicalization and the threat of social control (Conrad 2007).

As discussed in theories of niche construction, one interesting aspect of living beings is that they construct their environments – at least in part – as a function of their needs and interests, e.g. plants altering soil composition, beavers building dams, insects building underground nests, or humans reshaping entire ecosystems to produce various foods or constructing elaborate social institutions and technologies aimed at treating diseases (Dawkins 1982; Lewontin 2001; Odling-Smee et al. 2003). Organisms thus seem to value that which helps or hinders their activity and ability to adapt in an environment. As this valuation is part of what it means to be alive, it seems possible to naturalize values such that they are understood as expressions of behaviors in relation to desires, pleasures or needs, some of which are the result of conscious choices, as in humans (cf. Hamilton 2010). In humans, this biological valuation seems inseparable from social norms (behaviors and expectations), since humans have evolved to learn, replicate, represent, and transmit these norms. The values linked to a society's norms thus seem to be just as much a part of the human environment as air pollution and parasites, and, as we have seen in the preceding sections, can be just as detrimental to individual health. Thus, when conceptualizing health and disease, there is a necessary relation to biological valuation, as well as to human choices and behaviors – to social norms – and it is this that makes these concepts linked to values.

The practice of medicalization can also be seen as an expression of this underlying biological valuation. As I discussed in chapter 1, Canguilhem argues that the practice of medicine arose due to the existence of suffering individuals: it was the fact that disease was negatively valued by living beings (regardless of how the 'disease' was understood) that treatment was sought. Medicine as a human technique could thereby be understood naturalistically or biologically as 'an activity rooted in the living being's spontaneous effort to dominate the environment and organize it according it its values as a living being' (Canguilhem 1989, p. 228f). This is just as true today as it was for Hippocrates and Galen, or even those perceptive individuals in bygone times who stumbled across natural remedies in plants or animals. Humans have been seeking relief for their ailments for eons because we value health and disvalue disease on a biological level, as well as a social level (Fábrega 2011). To define health or disease without reference to values, or by separating them from the 'facts', is to miss these historical insights as well as the implication that (human) life entails

evaluation, e.g. the practice of remedying ails (cf. Murphy & Woolfolk 2000b for a similar claim). To naturalize values in this way would help account for how social norms play such a crucial role in regulating human behavior, in shaping what is considered pathological, and even in rendering individuals pathological. Thus, not only does the fact that medicalization has biological roots help support the view that medicine is inherently normative, but as organisms prefer health to disease, the question of values seems to run much deeper than human concerns.

Moreover, as Nikolas Rose (2007a) has pointed out, the very concept of medicalization is unclear, especially regarding the negative connotations often attached to it. Viewing the practice and institution of medicine as imposing norms on passive individuals misses how the history of medicine has been 'bound up with the history of the different ways in which human beings have tried to make ourselves better than we are' (2007a, p. 700). Medicine as an institution expresses the non-indifference humans have to their environments, to interpersonal relations, and to individual and collective suffering. For example, the social and economic changes that were the main drivers for improving the conditions of health in Western societies throughout the 19th and 20th centuries were based on the medicalization of living and working conditions, social inequalities, and the access to health care and health products (cf. Dubos 1965). If this is generally true, then can we assume that altering those environments with rigid social norms would have similar effects on the health of individuals? The medicalization of social norms, while seemingly metaphorical, might take on a concrete reality in terms of the psychological effects that pathogenic social norms have on individual experiences.

If medicalization is not merely a matter of 'treating individuals', but also involves addressing pathogenic environmental conditions, then could it also be a means to address the 'social pollution' involved in pathogenic niches and thereby help to redefine what it means to live in a given society? While it is assumed that the 'medical model' is mainly concerned with treating problems by altering individual behavior or biochemistry, medicalization need not be equated with 'pharmaceuticalization' (cf. Bell & Figert 2012): 'therapy' or 'intervention' can come in many forms, ranging from lifestyle changes (diet, exercise, changing jobs/cities, etc.) to psychotherapy (e.g. cognitive behavioral therapy) and various forms of socialization or normalization. In the case of diseases that arise due to harmful social environments, such as those discussed here, the most appropriate and effective kind of intervention would seem to be various changes on the social level. Despite the theoretical differences, this is in fact the general suggestion of Wakefield's account of relational disorders, as well as Murphy's example

of dysthymia. But how are we to understand such social changes? While medical social control has been criticized for transforming deviants into subservient citizens adhering to political-medical guidelines (Foucault 1977), or forcing individuals to adapt to the prevalent norms (Lock & Nguyen 2010), these views miss how medicalization is also a process whereby new forms of subjectivity are invented (Rose 1998).

To tease out the problem of social control, then, it might be helpful to distinguish various kinds of 'normalization', what I will call 'differential', 'conformist', and 'constructive', each with different consequences for the individuals involved. In *differential normalization*, there is an attempt to work on individual representations with an aim to see others as similarly different. In other words, what makes one unique or different is found to be rather common. This form of normalization, which is used in some forms of cognitive behavioral therapy, might be helpful as a means to mitigate one's harmful experience of eccentricity (Bentall 2009, p. 254). Homosexuals might come to find that their 'deviant' sexual behavior is not so deviant after all. While this can certainly be helpful for some individuals, the main limitation is that it does not address the social causes that led to the negative experiences. Even if an individual can see others as similarly different, this does not entail that the others will be more accepting of one's individuality.

In *conformist normalization*, the aim is to accept the norms of the group and adapt one's norms accordingly. This could be found in what Wakefield describes as 'psychological justice' (2006, p. 247), which is when psychiatry takes on the role of *adapting* eccentric, yet normal, individuals *to* social norms (2010, p. 342). This could be helpful when individuals feel alienated or lack a strong sense of self. However, this form of normalization seems to fall prey to seeing health as 'adjustment to society' and disease as a 'social maladaptation'. Also, it does not seem helpful for the problem of social norms discussed here, or even Wakefield's own account of relational disorders, since the norms involved are unjust and it is the relation to these norms which is pathogenic. It would likely be quite harmful to try to adapt suffering individuals to the very norms that are responsible for causing their pathology. Wakefield (2006) is thus right to worry about the 'dangers' that such an approach would entail, but he fails to see that this need not be the only way to understand a normalizing intervention.

Another form of normalization is needed to address the pathogenic social conditions without treating the suffering as mere social maladaptations. If we are dealing with socially-induced pathologies, then social reform seems necessary. *Constructive normalization*, then, would

entail that social norms can be altered to reflect individual variability in choices and behaviors. In other words, in a situation where the environment has become pathogenic to some individuals, the question is not to find a way to adapt these individuals to that environment, but to show how norms are changed by these individuals. A good example of this can be seen in the 'social model' of disability (Mulvany 2000) whereby the aim is not to 'fix' the disabled, but to change social norms and even a society's infrastructure so that the impairments are no longer disabling. Interestingly, this follows from the naturalistic account of values discussed in this section in that it reflects how organisms do not simply adapt to their natural or social surroundings, but alter them so as to reflect their needs and desires[151].

With this third form of normalization we come back to the issue of seeing social norms not as facts to be submitted to but as facts to be constituted out of the variety of individual values, as suggested in this passage by Canguilhem:

> it is enough that one individual in any society question the needs and norms of this society and challenge them – a sign that these needs and norms are not those of the whole society – in order for us to understand to what extent social need is not immanent, to what extent the social norm is not internal, and finally, to what extent the society, seat of restrained dissent or latent antagonisms, is far from setting itself up as a whole (1989, p. 256).

While social norms can take on the appearance of being fixed essences, individual variation in how social norms are experienced shows that what is assumed to be normal is not universally accepted. Consequently, social norms are unstable sites of contestation as they are (often) the result of contingent choices and behaviors which vary over time and space. In such a view, individual health is not merely about an absence of disease or dysfunction, but entails a constant struggle against that which prevents the individual from establishing a norm in a given environment (Dubos 1959), e.g. rigid social norms.

One interesting consequence of this view of normalization is that it accounts for how various judgments concerning certain diseases can vary historically and it is here that the history of medicine and the history of political struggles converge. Rather than arguing that changing disease judgments are simply a result of arbitrary changes in social values, this view

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[151] This view could also be related to that of 'critical naturalism', which argues that social norms and values are natural expressions of biological processes, but as they are historically and environmentally relative they are open to contestation (cf. Williams 1999; Pilgrim & Bentall 1999; Haslanger 2012, on 'critical realism'). It supports the claim that by naturalizing social norms we reveal not their rigidity but their contingency.

suggests that the judgments can change as the various aspects of the pathogenic niche change, e.g. the changing social norms and individual representations of them. So there may actually have been socio-historical reasons to assert that being homosexual in various societies in the past (and even in some societies today) was pathological, but that it is no longer so in some of those same societies insofar as the pathogenic niche no longer obtains. As I showed with the ideas of Hacking and Murphy, diseases seem to have a historical nature and come into and out of existence when the conditions for producing them change. Social values thus do play a role, but that does not make the judgments arbitrary.

This active niche-contestation could be seen, for example, in the gay rights movements across the globe, suggesting that prior to the expansion of such rights, the norms governing societies were sufficiently rigid or uncompromising so as to lead to the transformation of sexual variation into a diseased experience[152]. In the U.S., some positive outcomes have been recently witnessed in transgendered and openly gay mayors in communities which are otherwise rather conservative[153]. Within these social norms the individuals struggled to 'fit in', and suffered as a consequence, but by challenging the social norms, the social conditions leaving them disordered were dismantled. While this was done largely through political activism, the argument being developed here would suggest that it could be facilitated by medicalizing the norms producing the pathological experiences. This contextualization of health and disease, making them relative to contingent historical and cultural conditions, also helps to clarify the value of taking legal action against such discrimination, e.g. legalizing gay marriage. As humans, and seemingly all living beings, express their valuation of health over disease by responding to pathogenic conditions, one can find here some biological support for the legislation that would help undermine the formation of pathogenic conditions[154].

Understanding how these social norms were challenged, either on an individual or collective level, and the health changes that resulted from them, cannot be adequately accounted for by claiming that these individuals found 'psychological justice' by adapting to society's (unjust) norms. Instead, the 'justice' of normalization was achieved by society adapting its norms to fit the individuals, better reflecting the variation within that society. Wakefield (2006) might therefore be right to assume that 'treatment' of relational problems

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[152] This may also be the case when it comes to skin color and racist norms (Fanon 1952).
[153] For more on this see http://www.sturasmussen.com/realityCheck.htm.
[154] Cf. the social norms approach (Cialdini et al. 2006), UNICEF's educational and human rights campaigns against female circumcision and child marriages, or the CeaseFire program by Gary Slutkin that treats violence as an infectious disease.

can fall under the 'mental health professions', broadly construed, but he misunderstands the social implications of this. The medical model is not merely about treating individuals, but also about treating the society itself.

5. Concluding Remarks on Medicalizing and Pathologizing

The approach developed here thus provides a way to conceptualize the pathogenic nature of social norms such that we are not simply appealing to values to explain diagnostic differences, but to show their role in turning differences into diseases. Moreover, it is possible to conceptualize social pathologies without making questionable ontological claims regarding 'sick societies' or 'relational disorders'. By making health judgments relative to individuals in their environments (niches) we are actually better equipped to understand individual variations in experiencing social values, how individuals construct norms according to their needs and desires, and how social-historical conditions factor into whether and how something is experienced as a disease. Through a more constructive understanding of normalization processes, there seems to be a strong argument in favor of medicalizing social norms. If we medicalize social conditions, from poor living conditions to rigid social norms and violence, then medicine seems incapable of fully escaping the problem of social regulation. However, maybe we should be asking whether this is always negative since the actual suffering of individuals due to pathogenic social norms seems too great a problem to leave unaddressed.

While the problem of social control was crucial for the anti-psychiatry movement, in the end it failed to provide a convincing alternative and tended to valorize deviancy. What needs to be further clarified is how norms are constructed, such that the aim is not necessarily to get people to adopt what appear to be the dominant social norms, nor to simply 'be' different, but to protect individuals against harmful social norms and provide them with the means to critique and challenge them. If medicine, broadly construed, deals with the alleviation of human suffering and if social norms are part of the cause of such suffering then the medicalization of these norms need not have the negative connotations often attributed to it. By helping individuals to challenge pathogenic social norms through constructive normalization, those social institutions involved in medicalization could become the means by which individuals construct different ways of living, making medicine a tool for social change.

There is, however, one other interesting question that this account raises, though cannot be adequately addressed here: why do we seem to pathologize[155] some behaviors/conditions and not others? Some recent research into evolved disease-avoidance behavior could suggest an answer. We pathologize, at least in part, because morphological anomalies trigger evolved psychological mechanisms for disease-avoidance behaviors (Park et al. 2003). More specifically, this research suggests that we have evolved certain adaptive behaviors to protect ourselves from getting sick, such as reacting with disgust and avoidance when in the presence of someone who is ill. As it is more beneficial to react to anything that could be contagious, our psychological mechanisms tend to overshoot and react to that which is physically or morphologically anomalous. We react because the anomalous suggests a contagious abnormality. Some evidence for this has also been provided in terms of reactions to obesity (Park et al. 2007) and physical disabilities (Park et al. 2003), and has even been suggested to apply for anomalies such as facial disfigurements, facial and bodily asymmetry, old age, immigrants (Faulkner et al. 2004), and possibly even unusual behaviors (Kurzban & Leary 2001). The claim that these anomalies trigger disease-avoidance behavior, then, helps to explain why these individuals tend to be stigmatized[156] and possibly even pathologized.

Part of the stigmatization and pathological experience of homosexuality in certain environments, then, could be linked to the fact that for some individuals (or societies) who are more prone to disease-avoidance behaviors, homosexuality is seen as a behavioral anomaly and thus could trigger these reactions (Kurzban & Leary 2001). Other factors that might contribute to this are beliefs regarding whether homosexuality is a 'hygienic' form of sexuality or even whether homosexuality is linked to various diseases, e.g. AIDS. What is interesting about this for my account is that such psychological mechanisms could be what are triggered in what I described as pathogenic niches, especially if these niches are also pathogenic in the sense that there are many microbes, bacteria, etc. (Thornhill et al. 2009). Also, as pathogenic niches vary between cultures (and even within cultures over time), this would explain variations in the specific anomalies that are stigmatized in a given culture at a given time (Park et al. 2003).

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[155] While a full explication would exceed the space here, suffice it to say that medicalization and pathologization are different practices: seeing something as in need of medical treatment (medicalization) is not necessarily the same as seeing something as a disease (pathologizing). In this chapter, I gave an example of medicalizing social norms (treating their pathogenicity), that did not involve seeing the norms themselves as diseased.

[156] Though, disabilities can also trigger pro-social behaviors, e.g. compassion or assistance (Park et al. 2003).

The implications of this also extend to intervention in that changes in disease-avoidance behavior can come about when individuals are shown the irrationality of their beliefs, e.g. that there is something 'contagious' about being different (Park et al. 2003). This would complement my arguments regarding the medicalization of social norms. If social norms are seen as pathogens, then medicalizing these norms could play on these disease-avoidance behaviors so as to improve pathogenic social conditions. As one of Canguilhem's main claims is that we need to properly distinguish the anomalous from the abnormal, such potentially harmful conflations of anomalies and abnormalities provide interesting ways to apply Canguilhem's ideas and could help to explain the very practice of pathologizing.

Conclusion

> Diseases are a ransom eventually to be paid by men made to live without having asked for it, who must learn that they necessarily tend, from their very first day, toward an unforeseeable and inescapable end.
>
> Georges Canguilhem, *Writings on Medicine*

Through this exploration of Canguilhem's philosophy, I hope to have demonstrated not only the continued relevance of his ideas for the ongoing debates in philosophy of medicine, but also that the persistent lack of dialogue with his ideas is rather unfortunate. While some of these ideas can be obscure and his concepts a bit vague, the consequences of his general approach should not be overlooked. I would now like to recap some of the arguments from each chapter of this dissertation and then briefly mention some of their benefits and limitations.

While some claim that conceptual analysis has either come to an impasse or is itself misguided, a biological genealogy based on Canguilhem's philosophy was suggested as one way to set the debate in motion once again. The point of providing such a genealogy was not to discredit the other approaches, e.g. showing them to be arbitrary or unhelpful. Rather, the point was to show their shared roots and suggest that a different approach could be taken that integrates the normativist emphasis on valuation and subjectivity with the naturalistic emphasis on universality and objectivity. Such an approach could be a 'naturalized normativism', though the label is not that important. By revealing the biological conditions that allow for these accounts to emerge, i.e. the organism's valuation of the conditions of its life that can be seen in different ways of living or 'norms', the suggestion is that a more accurate approach should incorporate these conditions. While organisms value health, they do so differently depending on their unique organizational and behavioral capacities. The conclusion that seems to emerge, then, is that by appealing to these conditions we seem led to 'relativize' health and disease to individual organisms in their environments. The immediate problem that arises here is how exactly to determine this organismic valuation. Anosognosia was raised as a possible complication to taking an organism-centered approach and while Canguilhem recognized this as a problem, especially in the case of mental illnesses, he does not provide a clear response to it. At any rate, by beginning with a different biological theory, we can better see the implications of Canguilhem's ideas for the debate over the nature of health and disease.

If biologizing or naturalizing health and disease entails an appeal to individuals in their environments, then this seems to have some interesting implications for one of the strongest naturalistic accounts: Boorse's biostatistical theory. While there have been many critiques of Boorse's theory, one interesting issue that arises from reading Canguilhem is that of the distinction between normal and abnormal variation or, in Canguilhem's terms, anomalies and abnormalities. The question that Canguilhem raises is whether biology provides us with something fixed and stable in terms of 'species design' that will allow us to determine what is 'normal and natural', or whether there is something fundamentally variable about living beings that shows the limitations to such an approach. In Boorse, one problem of his 'normalization', or assuming an abstract and idealized normal 'design', can be seen in how he struggles to account for the variability of biological norms, such that there is no ideal organismic model to which individual organisms can be compared. What is 'normal and natural' varies as a function of organism-environment relations. Moreover, the example of how variations in height can have fitness diminishing effects showed that Boorse's account might actually over-pathologize some variations. Canguilhem helps to distinguish the anomalous from the abnormal not by referring the variation to a type determined by species-norms, but by using the criteria of whether a given variation allows a given organism to survive (establish a norm) in its environment. This implies that what is 'normal' will vary as a function of how an organism's unique organization is maintained in its environment. This was supported by looking at different accounts of 'function', one of which being the relational account, which defines function relative to a given set of selection pressures. A trait that was functional in past environments can lose its function as the environment changes, and new functions can also emerge in relation to changing demands. While this still differs from Canguilhem's 'eco-organismic' account by appealing to population-level accounts of fitness, it helps to show how something can be normal or functional in one environment, but abnormal in another.

This eco-organismic approach, however, faced some problems. For example, this view suggests that if a trait hinders an organism's ability to adapt to, or meet the demands of, its environment, then it would be pathological. If this is the case, then we seem incapable of preventing diagnostic abuses when thinking about social environments, e.g. considering political dissidence or masturbation a disease simply because they are traits that prevent the individual from 'adjusting to social demands'. This issue was illustrated by looking at homosexuality, where Canguilhem's approach seems to lead him to the controversial claim that

there is something pathological about homosexuality, at least relative to certain environments. While this is a controversial conclusion, I suggested that it might be more acceptable than is often thought and could have interesting therapeutic implications. Determining how it could be acceptable was left for a later chapter.

Two questions emerged from this initial investigation of Canguilhem's 'relativistic' ideas. First, while he seems to ground his understanding of normality in biological properties, is his account biologically coherent and tenable? Second, why should we rely on organism-level properties to determine health and disease, especially when biological theory makes use of various levels of analysis, from genes to populations? Both of these questions are raised by Élodie Giroux who presents an interesting, though misguided, critique of Canguilhem. Giroux argues that Canguilhem's position problematically equates individuals and organisms, which means he cannot account for other levels of biological organization, e.g. populations. For Giroux, since there is a way to see populations as individuals with properties invisible on the individual level, there is some reason to think that a property such as health would also apply on this level. While her ideas are not very convincing in themselves, an analysis of her critique allowed for some aspects of Canguilhem's philosophy to be further clarified.

As part of her critique turns on whether health and disease can be linked to biological individuality, I set out to show what individuality could mean in Canguilhem. Following Kurt Goldstein, individuality is to be understood in holistic terms: the parts of an individual organism must be understood in relation to the organism 'as a whole', since it is only relative to the whole that they take on normal or pathological qualities. While this remains a methodological suggestion in Goldstein, Canguilhem also employs it in ontological terms by appealing (1) to how organisms are uniquely organized such that the parts of an organism function in a causally interdependent or integrated way in relation to the organism as a whole, and (2) to how the organism's functions and behaviors are intricately related to environmental demands. His 'holism' implies, then, that individuality is shaped by social and environmental factors, which can be seen in the many international and inter-populational studies he cites. Giroux thus misrepresents his ideas when she claims that he over-emphasizes the 'individual' level and is thus blind to population-level analyses. Finally, I analyzed her own suggestion that we could transpose health to populations and showed why it is problematic and why Canguilhem's distinction between health and salubrity (the pathological and the pathogenic) is more helpful. We need to distinguish disease etiology and ontology and cannot overlook the

ways in which the transposition of health to populations is inescapably a political issue. While Giroux is right to point out that Canguilhem conflates individual and organism (since populations can also be 'individuals'), his criticism of applying health and disease to human societies, which are neither living nor *organisms*, still stands.

After this analysis, I still had to answer the question as to whether the biology used to support his ideas is still tenable. As he probably had 'organism' in mind when talking about biological individuals, the main question then becomes whether 'organism' is still a useful biological concept. Giroux's claim that the organism has been displaced from evolutionary theory rests on a heated debate in philosophy of biology concerning the levels or units of selection. While I doubt that this is really important to medical considerations, I explored how many recent philosophers and biologists are appealing to the concept of 'organism', or at least organism-level properties, to better understand evolutionary processes, e.g. development, plasticity, and niche construction. Contrary to Giroux's critique, it seems more possible than ever to defend an organism-centered view of (evolutionary) biology and to do so I looked at a couple recent ways in which the organism has been defined and the similarities they have with Canguilhem's ideas. In order to further drive home the point that Canguilhem is quite relevant to contemporary issues in philosophy of biology, I interpreted his concept of biological normativity in terms of species-level evolvability and organism-level plasticity. The interesting suggestion that emerged from this analysis was that there could be a way to link the concept of plasticity to that of health and disease, since plasticity can be used to show how organisms change and adapt as a function of environmental demands.

Before exploring that possibility, however, another way of relating biological and medical norms had to be explored: Darwinian medicine. The reason for exploring this area is primarily because some interesting ideas are presented regarding the role of environments for understanding current norms. As normality can vary as a function of different environments, some claim that it is possible to give precedence to some environments over others, e.g. the environment of evolutionary adaptedness (EEA) in the case of humans. While it is clear that specifying the ways in which our current environments differ from past environments can shed light on the vulnerability of our bodies and the complexities of disease etiology, there are many limitations when it comes to understanding what is currently normal or pathological relative to the environment. These limitations emerge largely because humans have never stopped evolving and adapting their environment to suit their needs. Moreover, even if we can show

that certain traits or functions exist now because they were selected in past environments, this remains insufficient to clarify what the current norms of health and disease should be. Consequently, viewing disease as a deviation from species norms, as a 'harmful dysfunction', or even as a disruption of evolved homeostatic mechanisms, fails to provide a coherent account. The problems with the homeostasis view allowed for another interesting concept to be explored, which was allostasis, or maintaining stability through change. Like plasticity, this concept is quite in line with Canguilhem's ideas. As Canguilhem's suggestion to begin with biological individuality and variability suggests, individuality will always haunt these evolutionary or etiological approaches precisely by forcing us to continually shift our concepts of what is 'normal and natural'. While evolutionary theory will clearly illuminate many aspects of health and disease, its insufficiency for determining what health and disease *are*, as well as the persistent fact that physiological explanations are more relevant for medicine, suggest that it is questionable whether it will be as 'foundational' for medicine as is often suggested.

After addressing the issue of past environments for understanding present medical norms, the next step was to tie together the various suggestions of the previous chapters so as to provide an 'updated' version of Canguilhem's account of health and disease. To do so, I first returned to the eco-organismic aspect of his work, here understood in terms of 'contextualism', whereby normality is determined relative to environments and can even vary between individual organisms. Not only can one organism be healthy in one environment, but not another, but the same trait could be pathological in one organism while posing no problem to another. This variability was also described in terms of what I called Canguilhem's 'surnaturalism', which is the basic idea that what is normal for living beings is to transgress norms, establishing new ones. In health, this is expressed by being 'more than normal', by being able to tolerate variations and establish new norms when necessary, whereas in disease it is expressed by the qualitatively new functioning that obliges the organism to behave differently, to constrict its functions or behaviors so as to survive.

This general framework of contextualism and surnaturalism was then compared with recent research into two concepts coming from ecological and developmental biology or physiology: phenotypic flexibility and biological robustness. These concepts describe seemingly universal properties of living beings to maintain their various functions amidst perturbations (robustness) by adjusting their morphology or behavior to meet environmental demands (flexibility). I discussed some ways in which these concepts help to explain pathogenesis, e.g.

the costs of being robust and flexible, as well as how robustness and flexibility can themselves become pathological. I then brought these concepts together to find a new way of expressing Canguilhem's definition of health in terms of robust organismic flexibility. In other words, health is the organism's maintenance of its organizational (robustness) and physiological (flexibility) capacities amidst changing demands, either internal or external. Conversely, disease was defined as a set of processes resulting in an unstable constriction of an organism's norms, i.e. its organizational and physiological capacities in its environment. Defining health in this way helped me to account for Canguilhem's contextualist claims that an organism's norms can only be understood relative to its environment, as well as his surnaturalism as health involves the ability to change and go beyond previous norms. With disease, this also helped to capture the contextualist approach such that it will be relative to the organism's norms in its environment that the line between robust flexibility and unstable constriction will be determined. As health and disease are a function of changing demands, this implies that there can be degrees of health and disease. Also, the fact that disease is characterized by qualitatively different norms than health was explained by how pathophysiological mechanisms seem to entail qualitatively different causal processes and can vary in ways that physiological mechanisms do not. Health is not the mere absence of disease and disease is not the mere contrary of health and so they should be understood as involving different types of biological processes, e.g. robust flexibility and unstable constraint. If one of the main problems plaguing the typical approaches to health and disease is that they insufficiently acknowledge environmental and individual relativity, then defining health and disease in this way seems to provide a more promising explanation of what health and disease are.

One main problem that emerges from this approach is that of operationalizing these concepts. While the usual way to do so is by appealing to statistical fitness, this will not work since, following Canguilhem, I see health as a property of individual organisms whereas fitness is a property of groups. I first considered the approach of ecological fitness since it seems closest to Canguilhem's concerns. As this is a property of organisms that explains whether they will survive in their environment, it seems possible that the definitions of health and disease I put forth could be further analyzed along these lines. Since being robust and flexible are what allow organisms to survive, an organism is healthy if its traits contribute to the maintenance of this robust flexibility in its environment. An organism is diseased if some trait or process results in an unstable constriction of the organism's norms, threatening its survival in its

environment. While leaving this option open, I also considered whether the concept of allostatic overload could provide a possibility for operationalization. I concluded by showing how an eco-organismic medicine could help to understand the environmental relativity of health and disease and thereby address some of the shortcomings of Darwinian medicine.

While a seemingly plausible picture of Canguilhem's contextualism was presented, one nagging problem remained, which was that of whether this 'relativizing' of health and disease runs into problems when human social environments are taken into consideration. While it might not be hard to imagine that someone with hypertension can undergo pathological experiences with changes in altitude, it is not clear whether individuals could also experience different social environments as pathological, as this seems to fall prey to pathologizing 'problems in living'. Part of the problem with understanding this is determining what is at stake when talking about 'social pathologies'. Following similar arguments as those used against Giroux, I think it is problematic to argue that societies and even social relations should be considered 'sick' in any non-metaphorical way. If we are to provide a coherent account of health and disease, then one requirement should be that what is pathologized should actually be capable of being ill. Societies and relationships, while likely harmful, are not living organisms and so not good candidates. Again, the pathogenic is not the same as the pathological.

Another way of understanding this issue was considered based on Hacking's and Murphy's discussions of niches, whereby various social and individual factors come together to produce pathological conditions. This suggestion helped me to make sense of Canguilhem's claim that disease can also involve a crisis whereby an individual struggles to live up to models of living, e.g. social norms. By contributing to the formation of pathogenic niches, social norms can be lived by some individuals as constraints on their thoughts and behaviors, causing them to experience these thoughts and behaviors as pathological. This idea helped to explain that controversial conclusion that homosexuals might experience their homosexuality as pathological in homonegative and heteronormative environments, but not in environments where these norms are absent. Moreover, rather than leading to the suggestion that 'treatment' should focus on individuals, the idea of a pathogenic niche producing pathologies of psychosocial origin implies that the very norms contributing to that niche are in need of being medicalized. By medicalizing social norms we are forced to ask whether the intervention needed is adapting individuals to these norms, or changing the norms themselves. Recent research into

disease-avoidance behavior might also help to explain how and why these pathogenic niches are formed, and even how they can be changed.

As a whole, the aim of this dissertation was to bring Canguilhem's claims and insights to bear on a series of debates within philosophy of medicine. By doing so, I was able to show not only that his ideas can still be defended some forty to sixty years after their conception, but also that his work provides interesting critiques of many prominent positions within these debates. Canguilhem's eco-organismic approach entails that what matters for living beings, in terms of their survival, is being able to meet the demands of their environment. Where this is possible, where the organism is capable of tolerating internal and external perturbations by flexibly altering its physiology or behavior, it is healthy. Where these perturbations force the organism into an unstable and constricted way of functioning, it is diseased. While Canguilhem stresses that health and disease are matters of 'experience', it might be best to interpret this as saying that health and disease are ways in which the organism lives in its environment: one way being open to taking risks and exploring new capacities, the other being closed off, forced to adhere to rather narrow norms so as to survive. 'This lived sense of health and disease is crucial for the patient, who finds his or her expectations and hopes managed by medicine, just as it is for the physician, whose efforts to cure are necessarily constrained by the patient' (Geroulanos & Meyers 2012, p. 10). Furthermore, making the individual organism the key reference class for understanding health and disease (disease being a deviation from the individual's norms), implies that the art of medicine is about determining what is distinctive about this individual in this environment, as each individual is a unique mixture of species, sex, age, life history, etc. norms. In other words, the individual organism's capacities will determine which perturbations result in constricted ways of living and these constrain medical judgments. This approach, then, would support the aim of developing an individualized medicine since therapy is not about treating types or imposing norms onto individuals, but about treating particular instances of pathological processes and helping the individual to find a new way of living. By helping the individual 'achieve a new state of equilibrium with the demands of the environment', the 'doctor's objective, like that of the educator, is to render himself useless' (Canguilhem 2012, p. 65).

This approach also highlights the difference between searching for necessary and sufficient conditions for the application of medical concepts as is done in conceptual analyses (e.g. 'what criteria can the class of things we consider to be diseases have such that a particular

case fits into it?') and trying to establish what *is* that actual thing or process in the world that we refer to by the concept of disease. Health and disease involve biological processes, which, in the rather complex human animal, take on various connotations, be they existential or social. Rather than appealing to some vague intuitions or the inherently mysterious realm of first-person experience, Canguilhem suggests that in order to understand health and disease we need a more nuanced *biological* understanding of these concepts that will account for and incorporate their existential and social meanings. It is not enough to determine whether a trait or function deviates from some abstract norm. What have to be determined are the *effects* of this deviation for this individual in its environment. In this sense, Canguilhem is a philosopher of context. Taking this approach entails that the question of interest for philosophy of medicine, then, is not whether naturalism or normativism is correct, but whether biology can clarify health and disease. In other words, debating on naturalism versus normativism (or a hybrid account) is problematic, not because naturalism is inherently incapable of accounting for variations and the subtleties of individual experiences, but because a more dynamic understanding of biological norms is needed. As the meaning of medical concepts is largely shaped by one's theory of nature, Canguilhem forces us to hold naturalism to higher standards, rather than abandoning it altogether or simply adding something to it. By approaching biological norms from the perspective of robustness and flexibility (or even allostasis), we might actually explain why it is that each organism experiences its health and disease uniquely and why it is that individuality may very well be a constitutive problem for medicine.

However, while Canguilhem requires an audience, he is not infallible. I mentioned the problem of anosognosia, but there is also the problem of determining whether his individual or organismic approach to health and disease can adequately explain congenital or inborn problems. These issues are further complicated when trying to determine how his definitions could be operationalized. I suggested a possible way, but what it gains in being consistent, it loses in being a bit vague. Furthermore, while I think there is a way to deal with the problem of whether contextualizing health and disease can escape social control and pathologizing problems in living, the suggestions remain underdeveloped. It may be the case that, just as there is no clear line between 'injuries' and 'disease', there is no clear line between 'problems in living' and 'mental illness'. If my account is plausible, it may always be up to the individual's capacities to determine the value of such distinctions. It might also be that such distinctions have more to do with therapeutic concerns than with ontological questions. These problems

remain open and it is possible that more recent areas of research, such as social constructivism or even the phenomenology of health and disease (cf. Carel & Cooper 2013), could provide ways to further explore and clarify Canguilhem's ideas. Finally, one general limitation to the approach used here is that, while I began with the idea that something other than traditional conceptual analysis is needed to understand disease, using Canguilhem as an example, the fact that I constantly dialogued with conceptual analytic approaches resulted in my own analysis being rather wedded to that framework. It might be helpful, then, to look further into other recent theories about disease, e.g. network theory, genetics, microbiology, etc. (Barabási, Gulbahce & Loscalzo 2011; Darrason 2013; Dupré 2012), and then see how/whether Canguilhem contributes to these theories.

If anything, the most important reason to take Canguilhem's ideas seriously is that they force us to rethink some of our basic concepts and the basis upon which they rest. By urging us to constantly challenge what it means to be 'normal and natural' on biological grounds, and by refusing to abandon the individual organism's capacity to determine the line between the normal and pathological, Canguilhem's ideas will remain relevant for some time to come.

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